THE
ELECTRICAL REVIEW.

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MUNICIPAL LOANS.

ONE of the assistant secretaries of the Local Government Board has prepared for the information of a Select Committee a statement respecting the practice of the Department in dealing with applications for loans, which is of much interest.

As to the purposes for which the borrowing powers are exercised, they necessarily cover all the undertakings of the municipalities, whether reproductive or otherwise, but the most important feature of the return lies in the periods fixed for repayments.

The principle followed appears to be based upon the estimated durability of buildings and plant, and the distribution of certain expenditure (such as costs of local Acts, and of promoting or opposing provisional orders) over a short term of years.

In dealing with electric lighting undertakings the preliminary outlay is spread over 25 years, that period being apparently considered as the equated life of the security in buildings and plant, but for loans for extensions various periods are assigned, as follows:—

	Years.
Cables	30
Transformers (other than motor transformers)	30
Switches and switchboards	30
Dynamos	20
Motor transformers and instruments	15
Accumulators and arc lamps	10

As we have pointed out in dealing with the question of depreciation, there are some differences of opinion among experts as to the proper percentage to be provided for each item of expenditure, but in some respects they agree; and it is of interest to compare their estimates of the life of the plant with the periods assigned by the Local Government Board for repayment of loans.

Thus in the matter of mains, which constitute so large a part of the outlay, 2½ per cent. is considered a proper provision for depreciation, or, say, a life of 40 years, whereas the Local Government Board fix the repayment at 30 years. In the case of accumulators the term of 10 years agrees with the expert estimate of 10 per cent. per annum.

For machinery, which would include engines, boilers, dynamos, &c., opinions differ. The Tunbridge Wells engineer worked out the depreciation on machinery at 4 per cent., but Mr. Lackie, of Glasgow, estimated this item at 7½ per cent., in the one case the equated life being considered as 25 years, but in the other only 13·33 years; the Local Government Board only specify in their table dynamos, for which they grant a loan for 20 years.

Why the period for repayment for the first installation should be shorter than for the additional works is not quite clear—in such items as cables, for example—but the principle adopted appears to be based on the estimated life of the plant.

Between the Local Government Board and the London

County Council there is a wide difference in the periods for which the loans are sanctioned, and for this want of uniformity in the practice of the two departments there is no explanation. In one respect the London County Council adopt the principle of not allowing fresh loans to be made for renewal of plant during currency of the loan for its purchase; in this way the value of the machinery for which the money was borrowed is maintained by charging the cost of renewal as a maintenance charge. The term for repayment is much longer than in the case of the Local Government Board—viz., 42 years for the first installation instead of 25.

A valuable return would be one showing the amount of every loan, with the sinking fund, the original cost of the plant, and the amount paid out of revenue for its maintenance or renewal.

If new loans are applied to renewing plant purchased by former borrowings, which have not been repaid, the basis established by the London County Council in fixing the term for repayment so far beyond the estimated life of the plant is ignored.

In the form adopted for the accounts of municipal electric undertakings, it is impossible to understand whether the expenditure of new loans on plant is or is not applied for renewals of machinery paid for out of borrowed money not yet wholly repaid.

Of course, an auditor appointed by the London County Council would see that the conditions of each loan sanctioned by them were complied with, and his certificate would satisfy the public; and so also in the case of the loans authorised by the Local Government Board; but, so far as the accounts themselves are concerned, there is nothing to show whether the capital expenditure during the current year covers the renewals referred to or not.

The L.C.C. Electrical Bills.

Municipal electrical trading has received a twofold check this week. First, the L.C.C. has withdrawn its Electric Supply (Companies Purchase) Bill, because the Government contemplates introducing a general measure on the question affecting the whole country; and, secondly, its effort to municipalise the fittings business has been defeated. It will be remembered that by Clauses 63 and 64 of the London County Council (General Powers) Bill it was proposed to make it lawful for the Council of a metropolitan borough which supplied electricity to supply fittings, not only to consumers, but to prospective consumers, and to borrow money for the purpose. As soon as this proposal came to our knowledge we raised our protest against it, and it is pleasing to notice that upon the motion of Sir F. Banbury the House of Commons came to the same conclusion on Monday last. It seems that the proposed clauses were not inserted in the Bill at the instance of the London County Council. According to Mr. John Burns, the Borough Councils who already supply electric light also desire to supply fittings, and in order to save expense and Parliamentary time, they agreed with the County Council for the insertion of the clauses in the General Powers Bill. He further stated that of the whole number of Councils 18 were in favour of the clauses and only two were opposed to them. If there is any one form of municipal trading which has nothing to commend it we think it is the supply of small articles by retail. It is argued, of course, that electric light is now a luxury only to be enjoyed by the rich, and that, if the local authorities were to assist, the poor man would be able to purchase fittings and have the best form of light in his own house. That may or may not be true; but it is to be remembered that every extension of municipal enterprise means a large increase in the staff employed by the local authority, and the supply of fittings would bring the municipality into direct competition with a section of its own ratepayers, viz., the electrical wares vendor and the installation contractor. We hope that all proposed extensions of the doctrine of municipal trading may be dealt with in the same way as the House of Commons has dealt with this matter, only we should like to see larger majorities than that of Monday last.

The Rating of Machinery.

To adopt a phrase made use of by Mr. Grant Lawson, the Rating of Machinery Bill appears each year in the House of Commons with the regularity of a recurring decimal. It was brought before Parliament on Friday last, with the result that the second reading was passed without a division. As was pointed out by one speaker, the title is somewhat misleading, the object to the measure being not to rate, but to relieve machinery from rating. The text of the measure is as follows:—

From and after January 1st, 1904, in estimating for the purpose of any valuation list, or poor or other local rate, the gross estimated rental and rateable value of any hereditament occupied for any trade, business or manufacturing purposes, any increased value arising from machines, tools, or appliances, which are not fixed or are only so fixed that they can be removed from their place without necessitating the removal of any part of the said hereditament, shall be excluded.

Provided that the gross estimated rental of any such hereditament shall be estimated at not less than the sum at which it might reasonably be expected to let for the purpose for which it is used on a tenancy from year to year, void of the machines, tools, and appliances which it might reasonably be expected would be supplied by the tenant, if the tenant paid all the usual tenants' rates and taxes, and if the landlord undertook to bear the cost of the repairs and insurance and the other expenses—if any—necessary to maintain the said hereditament in a state to command such rent.

Provided also that the terms "machines," "tools," and "appliances," for the purposes of this Act shall not apply to any machinery, machine, or plant used in or on the hereditament for producing or transmitting first motive power, or for heating or lighting the said hereditament.

Seeing that there is no statute upon the book which provides that machinery shall be rated, or that the value of machinery in mills, &c., is to be taken into consideration for the purpose of making an assessment, it is a seeming anomaly that there should be any necessity for the Bill under discussion. The fact is, however, that the judges have laid it down that in estimating the hypothetical rent for which a mill would let from year to year, regard must be had to the value of the machinery as enhancing the value of the premises. It is to the abolition of this principle that the efforts of the promoters of the Bill have for a number of years been directed. It is objected on the part of those who are not factory owners, and upon whom, in the ordinary course any burden of which the factory owners might be relieved must necessarily fall, that there is nothing to show that trade or manufacture is hampered by the present system; but it is an undoubted fact that mill owners have been in the past, and still are, put to great expense, first, by reason of the rates, and secondly, by reason of the fact that the present law is in a nebulous condition, and that each Assessment Committee has its own peculiar method of arriving at rateable value. We are surprised that in view of the fact that the Bill has passed a second reading upon several occasions, it has not been made a Government measure and placed upon the statute book long since.

THE NORTHERN COUNTIES ELECTRICITY SUPPLY CO.'S INSTALLATIONS.

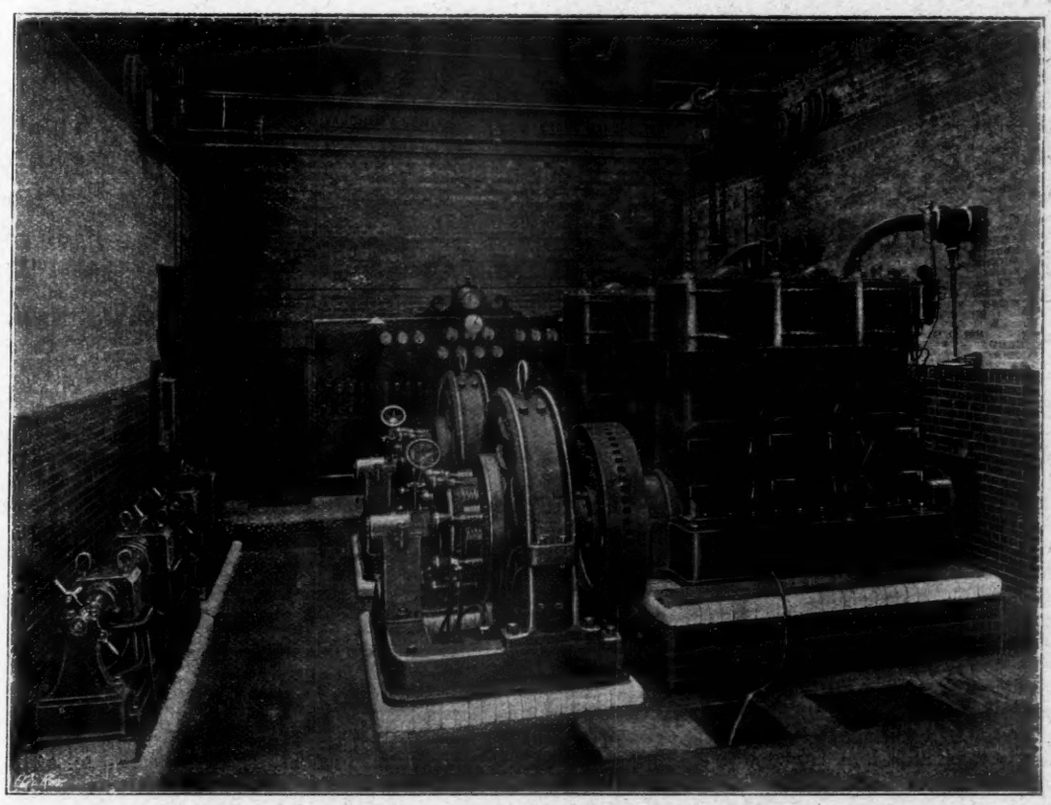
In the somewhat onerous task of popularising the many uses of electricity in the North of England, the Northern Counties Electricity Supply Co., Ltd., whose headquarters are at 13, Mosley Street, Newcastle-on-Tyne, has taken a very prominent part. Registered in 1900, the company has made rapid progress with its works, and now has the satisfaction of seeing three of them in active service, with the best of prospects before them. Recently our Tyneside correspondent had the opportunity, through the courtesy of Mr. C. W. Fairweather and Mr. C. S. Vesey Brown, the general managers and engineers, of seeing these stations, and observing, more particularly at Spennymoor, the method which the company has adopted of bringing the electric light within the reach of the working man and into the humble cottage of the pitman.

Spennymoor and Blyth are the largest stations at present, and of these Blyth is in some respects the more important.

Spennymoor is a town with a population of about 18,000, and until recently it was noted for the large ironworks of the Weardale Steel and Iron Co., while in the immediate vicinity are some important coal mines. It is the centre, too, in matters of trade for a large number of colliery villages. Unfortunately, when the power station of the Northern Counties Co. was about half built, the ironworks mentioned were, in the main, removed to the Teesside, and there is every prospect that the remaining portion will soon follow. Despite this, the work of construction was pushed ahead, and an admirably-equipped, well-built station was brought into existence; what is perhaps more remarkable, there are streets of cottages, dull, sombre-looking on the outside, that are quite luxuriously fitted out internally with electric light.

The station, of which a photograph is here reproduced, is equipped with two 200-kw. dynamos, built by Messrs. Crompton and Co., Ltd., of Chelmsford, each of which is driven by one of Messrs. W. H. Allen, Son & Co.'s three-crank compound engines, with cylinders 11 in., 15 in., and 15 in. in diameter, 9 in. stroke, running at 450 revolutions per minute, with 150 lbs. pressure. The engines receive their steam supply from a couple of Messrs. Babcock & Wilcox's boilers, which are fitted with mechanical chain-grate stokers. The boilers are fed by two electrically-driven pumps and a steam pump. The steam is exhausted into a jet condenser made by Messrs. Worthington & Co., working in conjunction with a cooling tower. The switchboard was supplied by Messrs. Dorman and Smith, of Salford. At the side of the engine room is the battery room containing the Chloride Electric Storage Syndicate's batteries of 400-ampere-hours capacity. Current is generated at 460 volts, and is distributed on the three-wire system to consumers at 230 volts. The task of laying the cables was entrusted to the Callender Cable and Construction Co., Ltd., London, and the work was carried out under the management of Mr. J. P. Mollard, under the supervision of Mr. G. Barnard. The feeder cables are of ·4 sq. in. cross-section, and the distributing cables are of ·1 sq. in., while the neutrals are connected with the station by ·075 in. cables. The cables are laid on the solid system, in wooden troughs, which are protected on the upper side by hard burned tiles.

Perhaps one of the most interesting features is the method adopted to bring the light within the reach of all consumers. This has been achieved by adopting the "free wiring" system, the effect of which is that the consumer has no initial outlay, but pays ½d. per unit extra. The services are so arranged that one service from the distributing cable serves two or more houses. In each house a meter is fixed, in the majority of cases prepayment meters being adopted. The supply given on the penny-in-the-slot system is one 8-c.p. lamp for 5½ hours per penny. The slot meter in use is that of the Rochdale Electric Co., Ltd.; the other meters utilised are those of Messrs. Chamberlain & Hookham, Ltd., and the Bastian Meter Co., Ltd. The slot meter system has become exceedingly popular, and there is scarcely a street without a number of electrically-lighted houses; in one street of about 40 houses, of the type shown in the illustration on p. 516, there is only one which has not the light



Generating Plant at Spennymoor.

installed. This is very significant when it is remembered that Spennymoor is in the very heart of the Durham coalfield, where, above all places, gas might be expected to be cheap. As a matter of fact, however, the superiority of the electric light is so obvious that its absence is rather the exception than the rule—that is, so far as the workmen's dwellings are concerned. The Spennymoor power station was only opened in May last year, and yet there are now over 6,000 lamps installed. As yet the demand for energy for motive power is coming on slowly, but already one works in the town is taking steps to have it installed to the extent of 60 H.P. Some 20 lamps have also been fixed in the streets, as part of the public lighting.

Alnwick, where another station of the company is situated, is a place of a very different character to Spennymoor. It is the "ducal" town, the home of the famous Percys; it is the centre of agricultural Northumberland, and consequently the conditions which the company had to face in

Electrically-Lighted Workmen's Dwellings in Spennymoor

arranging the system were very unlike those which they had to encounter in dealing with the first-named place. The company commenced supply in August last year with good prospects, for about 2,000 lamps were then being supplied, and now the number is above 3,000. A station was built in a convenient location near the gas works, and in this were installed a couple of two-crank compound engines, built by Messrs. Ruston, Proctor & Co., Ltd., of Lincoln, coupled direct to two 75-KW. dynamos by Messrs. Crompton & Co., Ltd. The balancers were also supplied by Messrs. Crompton & Co., Ltd., and the switchboard by Messrs. Dorman & Smith, of Salford. The steam supply is obtained from two Babcock & Wilcox water-tube boilers, fitted with chain-grate stokers. In the battery room there are 250 Chloride storage cells, with a capacity of 250 ampere-hours. All the cable work has been done by the Callender Cable and Construction Co., under the direction of Mr. J. P. Mollard. The feeders are ·3 sq. in. and ·2 sq. in. in cross-section. These are laid solid in bitumen. The "free wiring" system is largely adopted here also, an extra ½d. per unit being charged, which brings the maximum price up to 6d. per unit in the latter case. The slot system has met with much acceptance, a very large number of houses having been supplied in this manner.

The third station that the company has at present under way is that at Blyth, a port on the north-east coast. Some interest attaches to Blyth, inasmuch as it was the first urban district in the North of England which used electricity for public lighting, so far back as 1888 or 1890. The Northern Counties Electricity Supply Co. has here a generating station very similar to that at Spennymoor. Current is generated by two 200-KW. dynamos of the Crompton pattern driven by a pair of compound three-crank engines built by Messrs. W. H. Allen, Son & Co., while a pair of Messrs. Babcock & Wilcox's boilers are installed. The three-wire system has been adopted, the outer feeders being ·4 sq. in. These and the distributing cables have all been put in by the Callender Cable & Construction Co. The switchboard has been supplied by Messrs. Dorman & Smith. Almost immediately in rear of this are the batteries, of 250 ampere-hours capacity, supplied by the Chloride Electrical Storage Syndicate, Ltd.

At present there are 7,000 lamps connected, and a considerable quantity of electricity is supplied for motive power; the latter is encouraged by the company, which lends out motors on a rental. Blyth is a coal exporting place, and there is a good deal of work of a mechanical character done; many of the firms engaged in the latter have found it to be most advantageous to hire a motor, when the purchase of one, or of a gas or steam engine, would have been out of the question.

In all three towns the charges for lighting range from 5½d. per unit for 100 B. of T. units or less, to a minimum of 4d. per unit for a supply exceeding 1,100 units per quarter, and the charges for motive power range from 2½d. per unit for 500 B. of T. units or less to 1¼d. for 2,500 units per quarter. In each case 5 per cent. discount for cash is allowed for prompt payment.

In addition to what has been mentioned, the company has in hand a large power station at Hebburn-on-Tyne, which is laid out on the same lines as at Blyth; this is intended to supply power to all the large manufacturers in that area, and also to supply the company's sub-station at Felling.

The company has provisional orders for a large number of urban districts in Northumberland and Durham, which will be developed as the existing works are completed.

ELECTRIC IGNITION IN GAS MOTORS.

By Sir DAVID SALOMONS, Bart., M.A.

At the Paris Universal Exhibition in the year 1878 a few gas engines were shown, the first of their kind suitable for practical work. It is true that engines of this class were known before that date, but they could only be classed as tentative models, and quite unsuited for practical requirements. The engines shown at that Exhibition were termed the "Otto and Langen" (I believe Langen was the name of the second inventor), and in these machines the "Otto cycle" was non-existent. The mixture of gas and air was exploded under the piston without compression. It was not till a year later that the gas engine in its present form made its appearance. There is no need to describe this engine, as all readers of the present article must be conversant with it.

About the year 1894, what is known as the "petrol" motor came to the fore, chiefly in connection with road motor-cars, also for launches. Indeed, as soon as it was found that a satisfactory coal gas engine was possible, inventors turned their minds to gas engines worked by what may be termed portable gas. Benzine and other light spirits give off vapours which approach coal gas in their nature, and benzine, which is so extensively used to-day in connection with motors, is no more nor less than a kind of coal gas compressed into liquid form. In other words, the usual atmospheric pressure and the usual temperature which rule at the surface of the globe, cause benzine gas to assume a liquid form, and it can be so kept in closed vessels. Consequently it is no license to be permitted to class petrol, alcohol, coal gas and other motors of a similar character under the heading of gas motors. Indeed, in their construction all such machines, however varied they may be in design, have one main feature in common, that feature being that the gas which has entered the cylinder is compressed to a certain point, and then ignited by heat. In every instance, with two exceptions, an auxiliary apparatus is necessary to ignite the compressed gas. At the present time the two exceptions are (1) the Diesel engine, in which the compression is carried to such a point, that the heat so created ignites the gas; (2) those engines where a piece of spongy platinum is suitably placed in the compression chamber and becomes red hot at the right moment, and thereby ignites the gaseous mixture. It may be noted that the latter

method of lighting the gas has so far not proved satisfactory in practice.

The early gas engines used a flame to ignite the charge at the right moment. This was soon superseded by the ignition tube so well known at the present time, but for many purposes, especially for road carriages, it was thought desirable to ignite the compressed gas by electricity, in order to avoid all danger of a flame being so near to a volatile substance like benzine, the presence of which has already caused many cars to be burnt on the road, owing to leaky tubes and other reasons.

So far, this article has dealt more with the history of the gas engine than with the real subject intended to be discussed. It is not proposed to place before the reader the various mechanical devices which have been, and are, used in connection with electric ignition, nor to deal with any of the methods of ignition referred to which are not electrical. The object intended is rather to treat from the theoretical, as well as the practical point of view, the various modes of electric ignition, as well as the precautions which ought to be taken to prevent accidents. Many stationary gas engines are now supplied with electric ignition, and practically all motor-cars also have this. Since the latter greatly exceed in number the stationary class, the explanation and description which will be given may be taken to apply to these, but it must be remembered that for stationary and launch engines, the remarks made will be equally applicable except when reference is made to the manner of starting the motor, since stationary engines are usually started by turning the fly-wheel, or by one of the well-known automatic arrangements.

Electric ignition may be generally divided into the following classes :—

1. Engines using the sparking plug in connection with a primary battery and induction coil.

2. The same arrangement, but with an accumulator.

3. The same arrangement as No. 2, but in addition a small dynamo which can be used to charge the accumulators and supply the primary circuit of the coil at the same time, and in some instances to charge the accumulator alone or to supply the primary of the coil alone, these variations being mere details of arrangements.

4. A dynamo giving a high tension current, employing neither coil, accumulator, nor primary battery.

5. A battery, primary or secondary, which instead of producing a spark heats a filament of platinum wire red or white hot in the cylinder.

6. The same as No. 5, but using a dynamo, or a dynamo in combination with batteries.

7. A magneto which produces its spark in the cylinder by the separation of two points, *i.e.*, low tension current.

8. A magneto which produces a high tension spark in the cylinder.

9. A few other types which may be regarded as experimental, and therefore at the present time not worth while to consider, such, for instance, as the "influence machine" for producing a spark somewhat in the same way as the well known electric gas lighters.

In every instance it is essential that the spark, or whatever other form of heat may be used to ignite the gases, shall take place at the moment when they are in the state of greatest compression and the piston ready to make its run out, *i.e.*, just past the dead point. To carry this out may appear at first sight a very simple matter, and a very safe one for the party who starts the engine, since it would appear that the chance of the fly-wheel running backwards is entirely absent. In reality, to obtain the spark at the correct moment is by no means easy, nor is it free from danger to the operator. It has become a practice among makers and users of motor-cars to speak of advancing and retarding the electric spark or other source of heat. When we come to discuss this matter later, it will be seen that this is by no means the correct description of the state of affairs. It is only correct mechanically speaking, and not necessarily so otherwise. It is remarkable, considering the tens of thousands of these engines which are in use at the present day, how very few users really understand the principle of electric ignition, and the main object of this article is to place the matter before all those interested as clearly as such a subject can be made.

Coal gas engines generally have but one cylinder, but petroleum engines are found with one, two, three, four, and in very powerful engines with more cylinders. The single-cylinder type was taken up as a favourite by the well-known firm of de Dion-Bouton, and perfected by them to an extraordinary degree, not so much by new principles being involved, but by the perfection of manufacture and lightness which they were able to introduce owing to the large demand, which enabled them to manufacture on a very large scale. Multiple-cylinder engines represent to all intents and purposes the combination of a number of single cylinders suitably coupled for the purpose intended, to give off a maximum of power with the least amount of vibration, waste and noise. In considering the question being dealt with, it is better to dismiss multiple-cylinder engines and consider the mono-cylinder petrol engine, for it will be readily understood that if there are two cylinders, the ignition will be alternate in each cylinder, and so on when more exist. In other words, it is simply the same action repeated systematically by a mechanical device. This method of dealing with the subject filters out a great deal of complication, which in no way will help the reader to see the matter in a better light, and we have now only to see how the sparking or other ignition arrangement should work in an engine having one cylinder. To further simplify matters, it will only be necessary to consider the case of the spark ignition with, say, a primary battery, as all the conditions which are required to be fulfilled are present in other modes of electric ignition, though in certain cases some of the points to be discussed will be found absent; yet because the spark ignition worked by means of a coil and some form of battery is most common at the present time, a general discussion of this method would be more profitable than of one in which certain considerations which apply in these cases are absent, and would avoid misconception. However, a few remarks will be made later on with regard to other systems, and such points as would appear to require further explanation.

In the single-cylinder engine the ignition apparatus consists of the following portions :—

1. The primary battery or other source of electric energy.

2. The induction coil with a primary and secondary winding.

3. The necessary wires to complete the electric circuits.

4. The timing arrangement, *i.e.*, the mechanical portion which excites the primary of the induction coil at such moment that the spark produced in the cylinder shall be given at the right time.

5. The sparking plug which is screwed into the cylinder.

With regard to Nos. 1, 2 and 3, little need be said, as they are the usual apparatus known to all electricians. No. 4, viz., the timing apparatus, consists in almost every instance of a fixed platinum point and a movable one. These points can be brought into contact at definite moments to suit the circumstances of the case. They can be brought together by a negative action, *i.e.*, by means of a spring, which is held up during the time that the points are to be kept apart, the contact being produced by the spring becoming free. They may vibrate and produce a series of contacts. When this latter action takes place, it is most disadvantageous for the good working of the induction coil, notwithstanding the fact that some makers have stated that it is an advantage. In the other method the points are brought together by a positive action, *i.e.*, mechanically pressed together. It is evident that one platinum point must be insulated, whilst the other should be connected to the mass, unless the system be one where an insulated return wire is used, in which case both points are insulated. At all times when the platinums touch, the circuit is complete for the primary of the induction coil. The usual form given to the timing apparatus is that of a revolving circular cam with a notch or a depression in it for the negative action, and a boss standing up from it for the positive action. In the first case, the spring is fixed at one end and carries the platinum piece about its centre, having fixed at a suitable place a little metal finger. The circuit is completed when this finger drops into the recess in the cam. In the positive case, the boss on the cam pushes the spring in such a manner as to bring the platinum points together. In both cases the cam revolves one complete turn to two revolutions

of the fly-wheel, since the gas is ignited but once for every two strokes of the piston.

The following are the main considerations in connection with this apparatus which, in a sense, is the heart of the induction coil. It is essential that the primary current of the induction coil shall pass a given time in order that the iron core may become fully magnetised, and then the break occurs. If the period is prolonged, no advantage whatever is gained, but if shorter, the full spark the coil is capable of giving is not produced. It becomes therefore clear that if the coil is to produce as many as 600 to 800 sparks a minute, the iron core must be very soft and not large, for were the contrary the case, in order to get maximum results the coil and the battery would have to be on a very large scale and consequently heavy.

Considering first the negative timing apparatus, it will be observed that the time during which the primary current will pass must depend on the length of the notch in the cam, *i.e.*, the portion of the time during its revolution that the two platinums are in contact, and this time will vary directly as the speed of the engine; therefore if the engine is running at a very high speed, it is quite possible that the spring may not have the time, due to its inertia, to connect the platinum points at all, and in consequence miss-fires will take place. In fact, it is possible to run the engine at such a high speed that no spark would be created, and consequently the highest practical speed is that which suits the spring in the timing apparatus and the minimum time to excite the coil. The disadvantages, therefore, of this method of exciting the induction coil are, that there is a limit to the engine speed with any particular apparatus, and that a speed may be reached when an insufficient time is allowed for the passage of the primary current, whereby the spark is so reduced that unsatisfactory working results. In addition, there is another disadvantage, a mechanical one, viz., that the spring soon loses its elasticity, and the setting of the platinums has to be so close that constant regulation is necessary. With the positive method, the duration of the current depends on the form given to the boss on the cam, *i.e.*, whether it occupies a greater or a less portion of the circumference. Two disadvantages attach to this method. If the platinums are placed too close together, the position is equivalent to what is known as "advancing the ignition," and an accident may in consequence ensue; and secondly, the same drawback which occurs with the other type is present, namely, the induction current is reduced in point of time as the engine goes faster. But the platinum points may be set much further apart, and the risk of miss-fires due to this form of timing arrangement is reduced to a minimum. In practice it works far better than the negative arrangement, subject always to the care necessary that the setting shall not be such as to ignite too early. In the majority of engines the handle which is turned for starting keeps time with the piston. Let us assume that when the handle is uppermost the piston is at the end of its course, and when at the bottom the piston has run out. For the sake of illustration let it be assumed that when facing the handle it is turned in the direction of the hands of a clock, and that when the handle points to what would be 9 on the dial, the compression begins, and the spark should not take place in the cylinder until the handle is past what would be just 12, *i.e.*, the moment when the crank has passed the dead point, and the piston is about to descend. It is evident that if the spark takes place before the supposed "noon," the piston will descend, sending the crank round the wrong way and probably breaking the arm of, or doing some other mischief to, the operator. If the spark takes place after passing "noon," then the engine turns the right way, and the handle becomes disengaged and free by its construction. From the remarks which have been made, it is quite clear that the coil must be excited before the handle reaches the position when the spark should take place, because the time element enters to produce the induced current; therefore, if the operator were to move the starting handle too slowly between our imaginary 9 and 12, or hesitate whilst moving up to this hour, then the engine would be started in the wrong direction, with the possibility of a serious accident. That so few mishaps of this kind occur is due to the operator usually moving the handle very rapidly through this distance. It will be realised now why in the positive timing apparatus the platinums must not be placed too close together, or they would touch and create the spark long before our handle reached "noon." This might also occur in the negative arrangement if the platinums had been badly adjusted, but it is not so easy to make the error in this case as in the other.

(To be continued.)

CORRESPONDENCE.

Refuse Destructors.

Referring to your kind notice of our List No. 2 in your "Business Notes" on March 6th, will you permit me respectfully to point out that the figure which you quote for the output of electricity from Accrington requires some explanation? During the period of last year on which that figure of 20 units per ton was ascertained, the electrical output was not up to the full capacity of the destructor by a very long way, hence only a small portion of the heat developed by the destructor was utilised in the electricity works, and this accounts for the apparent discrepancy which you point out between the evaporation per pound of refuse and the units given per ton.

I have asked Mr. Newton, the borough engineer of Accrington, and he informs me that for three successive Saturdays (Saturday being the day of heaviest load) the results were as follows:—

Date	Refuse burnt in 16 hours.	Units generated.
Dec. 27th, 1902	40 tons and 1¼ tons coal	2,808
Jan. 3rd, 1903	40 tons, no coal	1,228
Jan. 10th, 1903	40 tons, no coal	1,600
	120 tons	5,636

If we allow 400 units per ton for the coal, we have 5,236 units of electricity generated by 120 tons of refuse, or an average of 42 to 43 units per ton, which is a good result. Mr. Newton points out that when a day load has been developed, these results can be greatly improved. Owing to the absence of a day load at present, the destructor is only run 16 hours a day, which means considerable daily loss in heating up furnaces and flues, and even for a large part of the 16 hours' run the electrical load is small, whereas the refuse has for sanitary reasons to be put through all the same. I am aware that these figures only cover short periods, but the fact remains that the electricity station is regularly run with refuse alone, and that the use of coal is an exception. I hope before long that I shall be in a position to place before you some figures obtained over a much longer run.

F. L. Watson.

Horsfall Destructor Co., Leeds.
March 18th, 1903.

Electrically-Operated Printing Machinery.

When I wrote you first on this subject I had hoped that much interesting information on the various systems of driving large printing presses would have been forthcoming. If one may judge from a recent meeting of the American Inst. E.E, the men with systems of economical speed control are not by any means modest in advancing the claims of their systems; here, although the ball has been set rolling in your columns, the apparent modesty of inventors has deterred them from entering upon any controversy. Your readers must not, however, imagine that the owners and patentees of such systems are naturally modest; if so, let one of them pose as a newspaper proprietor willing, nay anxious, to introduce the best system of electric driving, and let the fact leak out—in a day or two they will cluster round the office like flies round a jam pot, and overwhelm him with their exuberant verbosity! To return, however, to the subject proper, I trust you will permit me to reply to Mr. Justus Eck. How he could possibly discover that the tandem system has the efficiencies with which he credits, or rather *discredits* it, beats my comprehension; no brake horse-powers

were given, no statement of how much speed variation is obtained by field and armature control, yet Mr. Eck boldly tackles the problem and proceeds to tell your readers what I did not know myself, that the system has maximum efficiency at half speed! Lest there should be any misunderstanding as to the accuracy of his figures, Mr. Eck tells us that at full speed the efficiency is 66·6 per cent. Why it is not 67 or 66 per cent. Mr. Eck only can explain, but with the exception of half speed he is never within 20 per cent. of the actual efficiency.

Then your correspondent tells us that the high voltage of supply such as 500 on the outers need not trouble users of the Ward-Leonard system, thanks to the ingenuity of some United States Patent Attorney, who in drawing up a specification has discovered that if you boost 500 volts by 500 volts the result is not 1,000 volts. I, too, have known patent attorneys not far from the Strand who were equally ingenious. *De minimis non curat lex!*

About this 1 KW. to start a 60-H.P. motor on the Ward-Leonard system, your correspondent evidently assumes that the motor generator uses no power. The light load losses in a 20-KW. set must be nearly 3 KW., and if we have another 1 KW. to start the main motor, the total power drawn from the mains and paid for is 4 KW.

To Messrs. Geipel & Lange's communication I would say, the units used in the making-ready process *are* small, when a properly designed system is employed, though the *time* taken in the process is considerable. I did not base my calculations on the probability of the plant running continuously at full speed; indeed, I pointed out that one of the most serious objections to speed control by a back E.M.F. introduced into the circuit by a motor-generator was that at light loads too much energy was spent in keeping the motor-generator running doing little or nothing but opposing the main voltage, while at speeds in the region of full speed a large proportion, it may reach half the total power, is supplied through a motor-generator with the losses which result therefrom. Finally, I am not, as one of your correspondents infers, the inventor of the Bergmann system of tandem control.

Electra.

P.S.—I have just read Messrs. Geipel & Lange's second letter. Their figures may be correct for their own system, but their comparison with the tandem control system is obviously wrong, being based on Mr. Eck's figures. I have just examined one or two tests of the tandem system of control for 40 and 50-H.P. sets, and find it is in one case 88 per cent. and in another 90¼ at 80 per cent. of full speed.

I have been much interested in the correspondence on this subject, and in view of Messrs. Geipel & Lange's letter in your last issue, I would like to point out that they are not quite fair to what they describe as "the ordinary rheostat control."

To discuss in detail the requirements to be satisfied in driving rotary printing machines would occupy too much space, but the main essentials may be stated as—

1. Ease of control.
2. Large range of speed.
3. Rapid and extremely even acceleration.
4. Economy of current.

There are several minor points to be considered, but the first three points mentioned are absolutely necessary; if it is assumed that all the special systems are equal in these respects (though this is doubtful), then the last point will be the deciding one.

Of the whole range of speed, there are two parts over which the highest economy is desirable, viz., the slow, or "leading-in" speed—say from 1 per cent. to 5 per cent. of the maximum, and the running speed, say from 80 per cent. to 100 per cent. of the maximum; the economy at speeds intermediate to these is not of great importance, as these intermediate steps are only in use for a few seconds at a time, in passing from the low to the high speed.

As regards the current consumption on the lowest speed, claims have been made for the various systems, ranging from 6 per cent. or 7 per cent. to 33 per cent. of the full-load current, though I believe no authoritative tests have been published; this, however, is not the point to which Messrs. Geipel & Lange refer. It is on the high speeds that I venture to think that the Ward-Leonard system, admirable though it is in many respects, is at a disadvantage compared with other systems; and since the bulk of the work of the machine is done at the top speeds, this is a serious matter. Messrs. Geipel & Lange say that "at the 80 per cent. speed with the ordinary rheostat control there would be 20 per cent. of the whole energy wasted in resistance." This may be taken as sufficiently accurate if any engineer were likely to use series resistance control, but Messrs. Geipel & Lange surely cannot wish it to be supposed that this is probable, since it is well known that any good motor will permit a variation of speed of 20 per cent. by weakening the field, at practically full efficiency throughout this range, and that, if necessary, a much greater variation can be obtained in the same way by special design.

This being the case, the sentence quoted above savours somewhat of special pleading, and the despised "rheostat control" would appear to give better results as regards current consumption than the Ward-Leonard system, which is apparently at its best at half speed, a point at which the highest efficiency is of no great importance.

Rheostated.

Falling Trolley Lines.

With reference to Mr. J. C. Stewart's remarks in your issue of 20th inst., there is one great disadvantage with the automatic switch he illustrates, and this is, that in addition to opening when a break occurs in the trolley line, it would also operate when the current was intentionally cut off, which might be several times during the day, as well as at the finish of the day's run, therefore requiring attention after each cessation of current.

As Mr. Stewart is asking for information on this subject, I beg to refer him to page 342 of the ELECTRICAL REVIEW of August 29th, 1902, where is described an automatic device with the energising coil connected as he suggests, but which cuts out the section *only* when the current ceases from a break in the trolley line, and although the device as there shown earths the line and needs a short circuit current before it is cut out, it may be arranged instead to directly open a circuit breaker and secure the important advantage, mentioned by Mr. Stewart, of operating without an overload current, which arrangement, I might mention, is included in the patent of this device.

Frank G. Evans.

Bolton, *March 23rd*, 1903.

Gas Cooking.

As you have given space to your correspondent "$\frac{\pi}{4}$ awl" to twit me on my effort to enlighten the B.P. on this "burning" question, I trust you will find a small corner for my reply.

Your correspondent errs in attributing to my authorship the paragraph he quotes (third paragraph in his letter). These are the utterances of the well-known authority, Dr. Whitelegge, in "Public Hygiene." These words are also supported by quotations (immediately following in "A Ray of Light") from the eminent German chemist, Prof. K. B. Lehmann, in "Practical Hygiene."* I presume that even your anonymous correspondent would not have the temerity to challenge the standard works above referred to.

In reply to his humorous suggestion of the voluntary suicide of the malignant microbe in the interests of humanity at large, and of the gas consumer in particular, I would refer him again to the paragraph in "A Ray of Light," from which he has quoted, and which also gives the following:—

"It should, of course, be remembered that every flame

* Prof. K. B. Lehmann, in "Practical Hygiene," gives the following as regards the bacilli of tuberculosis, which he finds will die by exposure to 131° F. in four hours, to 140° F. in one hour, to 158° F. in ten minutes, and to 203° F. in one minute. (See pages 15 and 16 in "A Ray of Light.")

D

is in itself a centre of air circulation; and it is probable that a very large proportion of the air contained in a room lighted by gas finds its way either to the flame or sufficiently within its sphere of action to be thoroughly sterilised before passing away or being inhaled by the occupants."

If my proposition be unsound or unfair, it is open to your correspondent to refute it and to prove his case.

People who give hard knocks expect to receive hard knocks in return. For these I am prepared. But why cannot your correspondent, and other like-minded gentlemen, hit above the belt?

It is unnecessary for me to say more. Perhaps the next time "$\frac{\pi}{4}$ awl" presumes to measure swords with his competitors he will substitute facts for personalities and hard figures for sarcasm. Such treatment of his subject will be worthy of the steel of his opponents, win their respect, and add to the pleasure and zest of honourably fought-out controversy.

T. Ebenezer Pye.

Sandwich, *March 19th*, 1903.

Sparking Plugs for Automobiles.

From your note under my letter of the 13th inst. it appears I have missed something. Well, I am very sorry, and I hope automobilists will sympathise with me, for I sympathise with them; that is, those who have to resort to this method of ignition. The automobile engines that I have seen are trunk engines; with trunk engines properly designed and in thorough working order there is no need to use what I now see is called intensified sparks! especially when using the lighter oils, and it stands to reason that if the plug gets coated with carbon, the valves, piston rings, &c., will do the same, consequently the remedy is worse than the disease. When you ignite by the ordinary method you can form some idea as to the condition of the internal parts of your engine, but if you resort to the other method you can only guess at it, and before you know where you are it is a case of grinding in valves and cleaning pistons. Of course, there are times when it is necessary to resort to this method of ignition to keep your engines going, but on a motor-car these cases are few and far between, for no self-respecting motor-car would think of passing a decent hotel without stopping.

Automobilists may find (according to the type of coil used) that this interposition of a spark-gap in series with another gap may compel them to raise the E.M.F. of the primary circuit, and this may give trouble at the circuit-breaker contacts. These fuse and form like a small arc lamp crater, and eventually fail to break the circuit; this can be overcome by using a metal, other than platinum. This was first tried in America, and afterwards in this country; but it did not find favour here, although it answered its purpose. This may be in use again for all I know, or perhaps it still remains to be rediscovered.

The bridging of the sparking points with a light sooty carbon is often caused by a deodoriser which has been added to the oil, and automobilists should see that they use only pure oil before resorting to the intensified spark.

When at sea you often work under very trying conditions: occasionally you get caught on a lee shore, or in a tight corner, like making the Pentland Firth on a dirty night, where, if your engines fail to ignite, you will soon find yourself floundering among the breakers; these are the times to learn a few wrinkles about sparking plugs. I have seen us scull around the North Atlantic for 14 or 16 days between the Pentland Firth and Iceland, then run home and arrive in dock, say, to-day and away again the next night. This does not give you much time to open out your engines, and I doubt if there are many trunk automobile engines that would stand this long when using the intensified-spark method of ignition.

W. McL. Dann.

[The worst trouble with the ignition plug is met with in the early stages of the life of a petrol engine, when the cylinder is purposely overfed with lubricating oil, and it is at these times that the advantages of the external spark-gap are most noticeable. But apart from this, we do not agree with our correspondent as to the use of the ignition plug as an indicator of the degree of sootiness in the cylinder; it is well known that the spark itself has a powerful effect in depositing carbon out of the oil, and therefore the spark-gap may become fouled while the cylinder and the piston are comparatively clean. A very small external gap suffices to give the desired effect, so that the increased work thrown on the coil is unimportant.—Eds. Elec. Rev.]

Some Notes on the Commercial Management of Tramway Undertakings.

I read with pleasure Mr. C. H. Wordingham's remarks on the second portion of my article which appeared in the February number of *Feilden's Magazine*. His opening remark that it is essentially a series of notes is quite relevant, as the heading points out.

I am glad to note, regarding my remarks on signalling, that Mr. Wordingham gives an instance where this system would have been instrumental in stopping a car within a reasonable distance from the swing bridge mentioned, and averting what otherwise must have been a terrible calamity. I think, as a double precaution, his suggestion of cutting off the current from a sufficient length of trolley wire, to warn the driver in the event of over-running, is an exceedingly good one, which, of course, only applies to cars fitted with magnetic electric brakes, and maintain that if you have drivers who will not recognise the danger signals, such means of stopping the cars becomes necessary. In the instance quoted by Mr. Wordingham, had the swing bridge been open, it would certainly have been a bad job for the car, and I feel convinced that any reasonable authorities would adopt some arrangement of this nature for cutting off the current from a length of trolley wire when the signal was against the car, especially on such a dangerous route as where the tramway system is carried over swing bridges.

Illustrating the importance of the adoption of signalling on the route cited above, and also at dangerous points, the accident which occurred at Gateshead last week during the strike is interesting.

"An amusing, though alarming accident occurred last Thursday. A car, driven by a novice, jumped the points at a sharp turn on an incline, and precipitated itself into the bay window of a public house, tearing the front of the building almost entirely away, and leaving the motor-man involuntarily interviewing the astonished barman inside the public house, and asking him whether his car came under the new Act or not." Fortunately no one was seriously hurt.

Referring to his remarks regarding tramway wattmeters giving trouble, there were no doubt many broken jewels and pivots in the early days, but experience has brought out a serviceable meter, and tramway wattmeters for recording the amount of current consumed have now been so designed by manufacturers, that practically all vibration is taken up, and the main function of the instrument, viz., recording the exact amount of current consumed, is perfectly satisfactory; and I think it singular that Mr. Wordingham does not approve of this method of checking the current consumption of the cars, as you can hardly consider the equipment of a car complete without knowing exactly under what conditions it works. In fact, to say that wattmeters are unnecessary on tramcars is equivalent to saying that you should run a locomotive without measuring the coal consumption from the tender, which, on some railway systems, is carried out very stringently. I maintain, therefore, that tramway wattmeters are essential to the proper equipment of modern cars, as they give an exact record of the current consumption of each motor; for although the motors may be exactly similar, the amount of current used is ever a varying quantity, the cause and reason whereof I am not at this juncture prepared to take up. I will, therefore, switch off and connect myself up with his esteemed views on the danger resulting from a trolley head being reversed at night, when the car is not clear of passengers.

I feel certain that this question must be apparent to any one who has seen a car laden with passengers at any terminus which is not well lighted with arc lamps or some other means; and although this sounds a very trivial question, it

is, indeed, one worthy of special notice at many termini at the present time throughout the country. Especially is this the case if such a terminus exists at the end of a route running from clubland.

With reference to the question of life-guards, I regret to see that Mr. Wordingham treats this in a somewhat humorous vein, but, at the same time, quite agree with him that the type of life-guard illustrated is not of the most approved pattern. But I still maintain that the question of life-guards is one of vital importance to tramway systems generally, as shown by the following extract from the report of a case brought against the Blackpool Corporation, and tried by Mr. Justice Walton and a special jury :—

"It was alleged that the defendants had not fitted this car with such a guard as it was their statutory duty to affix to it. The Board of Trade regulations under which the Corporation held powers to work their electric tramcars required that each tramcar should be fitted with a suitable fender, which should act efficiently as a life protector."

I am glad to note that the type of guard illustrated in my article has been condemned and taken off all the tramways in Manchester, which have now been fitted with the drop-gate type of guard on the Tidswell principle. No doubt the provision of effective life-guards will be one of the most important matters that tramway authorities will have to deal with, as, in the ordinary course of pedestrian traffic, it is no unusual thing to see people dart across the street, without looking either way, and, being unaware of the approach of a car, they do not realise, till the shock comes, that George Stevenson's remark regarding the "coo" applies with equal force to the pedestrian when a tramcar strikes him.

The most interesting portion to which Mr. Wordingham alludes is the question, which, I am glad to note, is exercising itself in his mind, and which is of vital importance, namely, the over-crowding of tramcars; there are many who have been in the same position as himself, and had to sit in an over-crowded car, which is extremely disagreeable when travelling a distance taking 20 minutes or more. The atmosphere gets vitiated; the conductor cannot collect his fares; it allows the unscrupulous person to get a cheap ride at the cost of his fellow ratepayers; it is a very bad thing for corns and patent leather boots; but for more specific reasons than these the practice should be condemned by any reasonable thinking authorities, as the present system of over-crowding is one that will bring a falling-off in fares and discredit to the system, and no doubt many will revert back to the at one time despised suburban railway train (with a subsequent loss to the tramway undertakings), where at least the person who had regard for his health, and was willing to pay, had the satisfaction of being able to change from one compartment to another; and it is to be hoped that eventually the Board of Trade will take this question up, and not allow it, as at present, to be left to the discretion of tramway conductors or avaricious committeemen.

T. W. Sheffield.

LEGAL.

Marryat and Another v. Anti-Vibrator, Ltd.

In the King's Bench Division on March 18th before Mr. Justice Wright, sitting without a jury, this case was heard. The plaintiffs, Messrs. Marryat & Place, electrical engineers, of Covent Garden, claimed against Anti-Vibrator, Ltd., manufacturers of automobile cars, of Croydon, to recover £171 in respect of work done and damages sustained by alleged breach of an agreement. The defendants denied liability. Mr. Hammond Chambers, K.C., and Mr. Hollis Walker appeared for plaintiffs; and Mr. Scrutton, K.C., and Mr. Kay for the defendants.

It appeared that in the early part of 1902 the defendants required some electric motors for cars which they were constructing, and they entered into communication with the plaintiffs. In May the plaintiffs came across some motors which were being manufactured at Brunswick, in Germany, and they alleged that after some negotiations the defendants ordered some 12 of these motors, two to be delivered in a month and the remaining 10 at the rate of two a month. Two were delivered to the defendants, and certain work was done to the other 10 before the order was countermanded. Plaintiffs contended that they were entitled to £66, the price of the two motors delivered, £44 in respect of work done in connection with the undelivered motors, and £45 for loss of profit. Defendants alleged that the motors would not fit their cars, that they were not in accordance with contract, and that therefore they were entitled to reject them.

Mr. Justice Wright, after hearing the evidence, found for the plaintiffs for the value of the two cars, and for the defendants with regard to the other 10. Plaintiffs were allowed £20 costs.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Mar. 25th, 1902.		Week ending Mar. 24th, 1903.	
Adelaide	Value £400	Amsterdam	Value £60
Aden. Teleg. mat.	964	Auckland	20
Alexandria	42	Beira	190
Amsterdam	115	Bombay	311
Bombay	76	Buenos Ayres. Teleg. cable	600
Bremen	80	,, Teleph. cable	170
Calcutta	1,180	Calcutta	1,781
,, Teleg. wire	512	,, Teleg. mat.	153
Callao. Teleg. buoys	34	Cape Town	1,872
Cape Town	957	,, Teleg. mat.	420
Cartagena	65	Christchurch	34
Channel Islands	91	Colombo	170
Christchurch	42	Copenhagen. Teleg. mat.	80
Copenhagen. Teleg. wire	18	Delagoa Bay	31
Durban	1,560	Durban	1,349
East London	1,028	,, Teleg. mat.	2,801
Fremantle	13	Fremantle	116
Gibraltar	46	Gibraltar	142
Hobart	15	Hamburg	25
Karachi	100	Hong Kong	97
Liban	60	Labuan	21
Lisbon. Teleg. cable	900	Lisbon	13
Madras	280	Madras	725
North Atlantic. Teleg. cable	1,840	,, Teleg. mat.	96
Port Elizabeth	196	Melbourne	80
Rio de Janeiro	24	Nagasaki	1,788
St. Petersburg. Teleg. cable	185	Nordenham. Teleg. cable	860
Shanghai	604	Otago	150
Sydney	347	,, Teleg. mat.	40
Syra. Teleg. mat.	90	Penang	3,508
Valparaiso	230	Perth	123
Wellington	1,994	Port Elizabeth	207
		St. Petersburg. Teleg. cables	1,544
		,, Teleg. mat.	800
		Shanghai	40
		Singapore	135
		Suez. Teleg. mat.	225
		Sydney	226
		Valparaiso. Teleg. cable	2,905
		Wellington	237
		Zanzibar	34
Total	£13,968	Total	£24,519

Foreign Goods Transhipped.

Calcutta. Elec. apparatus.	Value £29	Gothenburg. Elec. appa.	Value £48
Durban. Elec. goods	48	New York. Elec. apparatus	104
Hong Kong. Elec. mat.	12		
New York. Elec. goods	80		
Total	£169	Total	£152

Bankruptcy Proceedings.—The first meeting and public examination in *re* G. K. Gilchrist, electrical contractor, St. Annes-on-the-Sea, are to be held on March 30th and April 3rd at Preston.

The last day of receiving proofs in the case of J. Worthington and Co. (J. F. Worthington and G. Nuttall), electrical engineers, of Hanley, is April 4th.

A first and final dividend of 6¾d. in the £ is to be paid on April 3rd in the case of Lewis Bayliss, electrical accessories manufacturer (F. Terrill & Co, Cordwell & Co., and Thames Electrical Manufacturing Co.).

Dissolutions and Liquidations.—A petition for winding-up the Mica Manufacturing Co. will be heard on March 31st.

A petition for liquidating the Warrington and District Light and Power Co. will be heard on April 2nd at Warrington. Messrs. Simon Berry & Co. are the petitioners.

A petition for continuing the winding-up of the Commercial Development Corporation under the supervision of the Court, will be heard on March 30th, at Manchester. The company passed winding-up resolutions last September, and appointed Mr. S. A. Bartlett as its liquidator with an advisory committee. It is the members of this committee who are now presenting the above petition.

Members of the Newhaven and Seaford Electric Lighting Co. are to meet on April 24th at Sleaford to hear an account of the winding-up from Mr. E. T. Wellsted.

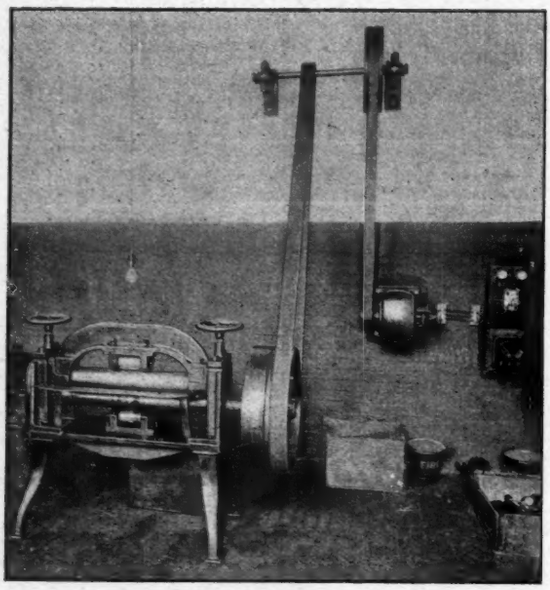
The *London Gazette* has withdrawn its notice announcing first meetings in *re* New Imperial Electric Lamp Co. for March 24th.

First meetings of creditors and contributories in *re* H. M. Salmony & Co., are to be held on March 31st, at Carey Street.

On account of inability to pay debts, the United Electric Wire and Telegraph Works, of 14A, Clerkenwell Road, London, is winding up.

Directory.—*Street's Newspaper Directory* for 1903 (8, Serle Street, W.C. 3s. 6d.) is as usual a most conveniently arranged index to the press of London and the provinces, and it also covers in part Colonial and foreign papers. The list is arranged both alphabetically as to names of papers and geographically as to the places of publication.

New B.T.H. Motor.—The British Thomson-Houston Co., Ltd., are introducing a new D.A. type of motor, the principal features of which will be gathered from the following particulars:—To ensure simplicity, the number of component parts has been reduced to a minimum, and they are of the simplest character. They are exceptionally free from chattering, humming and vibration—difficulties which are an ever-present source of trouble where quiet running must be maintained. The D.A. motors are manufactured in sizes of ¼ H.P. to 15 H.P. for slow speed, and 2 H.P. to 20 H.P. for moderate speed. Standard windings have been developed for the nominal voltages of 115, 200, 230, 400 and 500, and the speeds range from 2,000 r.p.m. in the smaller down to 750



D.A. Type Motor Driving Straightening Rolls.

r.p.m. in the larger sizes. Their construction has been carried out on the well known lines adopted by this firm, and is such as to ensure cool running and practical freedom from sparking. In these machines the bearings are carried by the cast-iron end shields which can be unbolted and rotated through angles of 90° or 180° so that the motors may be easily rendered suitable for bolting sideways to a wall, or in an inverted position on a ceiling. The "cylindrical" armature winding employed on other B.T.H. motors is also used in this type. The standard motors are shunt wound, but series wound motors can be supplied for use on cranes, winches,

Parts of D.A. Type Motor.

&c., where a variation of speed with load is required, while for printing presses and other machines requiring large torque at starting, compound-wound motors are recommended. All parts are made to gauge, and duplicates can be obtained at any time from stock. Gear shafts can be supplied mounted on the motor itself in which case the ordinary end shields of the standard D.A. motor are replaced by special ones carrying bearings, in which the secondary shaft revolves. Gear cases and five standard gear reductions are provided from 3 to 1 to 8 to 1, and these reductions are interchangeable on each size of motor respectively. By rotating the end shields relatively to the feet of the motor three alternative positions of the secondary shaft are obtainable, and, when required, a belt tightener device can be supplied which permits the use of motors in driving machines which ordinarily require a lower speed than can be obtained by belting from standard motor pulleys.

Automatic Point Shifter for Trolley Lines.—A device for electrically operating the rail and overhead points on trolley lines, enabling this to be effected at will by the driver without either him or the conductor leaving the car, has recently been installed on the Woodhouse Street route of the Leeds Corporation tramways. The apparatus is contained in a cast-iron pillar, similar to the ordinary section box, fixed at the side of the road near the point. This contains a large electro-magnet and a switchboard fitted with the relay switches, fuses, &c. It communicates by means of a rod with the point tongue, and with the overhead point by means of a wire or thin rod. There are also three leads, one tapped on to the trolley wire, and one to each of two studs set in the track. One of these studs is fitted 7 or 8 yards in front of the point, the other a similar distance past it. The car is fitted with a switch at each end, one side of which is in each case connected to the main trolley lead, while the other goes through a fuse to a skate or slipper suitably fixed beneath the car, and between the motors. On approaching the point, if it is desired to turn to the branch line, the driver puts his switch over, thus putting the skate in connection with the trolley wire. On passing over the stud current flows to a relay switch in the pillar, and actuates the main magnet by means of current direct from the trolley wire. The point is then pulled over simultaneously with the overhead frog. The car having passed through, it again makes contact with the second stud, and the current sent through now releases the switch, thus disconnecting the main magnet, and releasing the points, which return to their normal positions. We are informed that the apparatus, which is the invention of Mr. W. H. Turner, has now been at work without a hitch for some weeks, and was previously tried for a time at the Kirkstall Road car depôt. The patentees are Messrs. R. E. Dixon, T. B. Stewart, W. H. Turner, and the apparatus is manufactured by Messrs. S. Dixon & Son, Boar Lane, Leeds, from whom all information may be obtained.

Trade Announcements.—Messrs. David Brown and Sons have removed their gear-cutting department to Park Gear Works, Lockwood, Huddersfield, where new and specially equipped factories have been built. The wood-pattern works will be continued at East Parade, Huddersfield.

Messrs. W. J. Crampton & Co., electrical engineers, have removed to 73, Queen Victoria St., E.C.

The Cinque Ports Electrical Engineering Co., of Hastings, have, in consequence of increasing business, transferred their business from 14, George Street, to 186, Queen's Road.

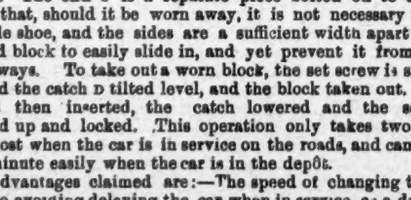
Messrs. Wallis-Jones & Dent have removed their offices from 36, Great George Street, S.W., to 50, Queen Anne's Gate, S.W.

Mr. Charles Sillar has removed from 33 to 69, Renfield Street, Glasgow, where he still continues to represent Messrs. Witting Bros. and Estler Bros., of London.

The works and offices of the Mica Insulator Co. have been removed to Blackhorse Lane, Walthamstow, E.

E.P.S. Batteries.—We mentioned in our "Contracts Closed" last week that the L.C.C. had placed an order with the Electrical Power Storage Co. for a new battery for the Cranbourne Street electricity meter testing station. We read in the report of the Highways Committee that the battery which this one is to replace has been in use for upwards of 13 years. It was supplied by the E.P.S. Co., and worked in a very satisfactory manner. The fact of its long service weighed largely with the Committee in giving the contract to the E.P.S. Co.

Slipper Brake Blocks.—Mr. H. Baron, of the Huddersfield tram depôt, has provisionally protected a method of fixing wooden blocks on slipper or track brakes for electric cars, of which we give a sketch below. A is the iron brake shoe, and

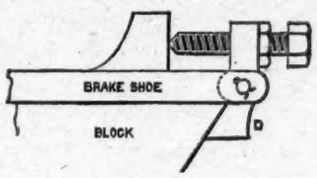


B is the wooden block, which is made of dove-tail shape. One end slides into the end C, and the other end is clamped by the catch D, which can be tightened up by the set screw E binding against the lug F on the brake shoe, and the screw is fastened by a lock-nut. The end C is a separate piece bolted on to the brake shoe, so that, should it be worn away, it is not necessary to renew the whole shoe, and the sides are a sufficient width apart to allow the wood block to easily slide in, and yet prevent it from coming out sideways. To take out a worn block, the set screw is slackened back, and the catch D tilted level, and the block taken out. A fresh block is then inserted, the catch lowered and the set screw tightened up and locked. This operation only takes two minutes at the most when the car is in service on the roads, and can be done in one minute easily when the car is in the depôt.

The advantages claimed are:—The speed of changing the wood blocks, so avoiding delaying the car when in service, as a driver can easily renew the blocks himself at a terminus; no necessity to take the car to the depôt to have fresh blocks fitted; however much the blocks may wear down, they are always held tight; no wearing away of coach screws, or necessity of bolts, &c., to hold the blocks in place; blocks may be used of unequal lengths, as the catch D can adjust itself; blocks varying as much as ½ in. in length have been rigidly held.

As for tests of security, a car was allowed to run down a gradient of 1 in 14 and was pulled to a stop by the use of slipper brakes

only. On a similar gradient the brake was put hard on, and full power applied to the motors, but the brake was sufficient to hold the car against running away. Below is an enlarged sketch of the end with catch D.



Catch D swivelled between two lugs on brake shoe.

We are informed that this method of securing and fixing the blocks has met with the highest praise from those who have used it, both from drivers on the road and the brakesmen in the Huddersfield depôt. The arrangement shown is for shoes having central guides, but it is equally adaptable to shoes having guides at the ends.

Parliamentary.—The Standing Orders Committee of the House of Commons have considered the Bills, which were found not to have complied with Standing Orders, and have made the following recommendations:—*Harrow Road and Paddington Trams.*—That the Bill be allowed to proceed, providing that tramways Nos. 1 and 2 be struck out. These are the only two lines proposed to be constructed, so that now the Bill only seeks power to electrify the existing lines, and to transfer the undertaking to the Metropolitan Electric Tramways undertaking. *Metropolitan District Railway (Various Powers).*—On condition that Railway No. 1 in the Bill is struck out Standing Orders will be dispensed with, and the Bill allowed to proceed. *Wigan Corporation Tramways.*—Standing Orders will be dispensed with if tramways Nos 3 and 4 are struck out. *London County Council Tramways and Improvements.*—It is recommended that the Bill be allowed to proceed on condition that Tramways Nos. 1, 2, 8, 8A, 9 and 9A are struck out. The tramways thus struck out is a line from Hampstead Road, along the Tottenham Court Road; from Edgware Road to the County Boundary at Cricklewood; from Greenwich through the Blackwall Tunnel to the East India Dock Road; and from Deptford *vid* Blackheath Road and Shooter's Hill Road to Woolwich. *Sheffield Corporation Tramways*—Tramways No. 2 and 2A will have to be struck out of this Bill. Mr. Campion (Examiner) found further Standing Orders proved in the case of Wellingborough and District Tramroads, South Shields, Sunderland and District Tramways, and Metropolitan District Railway (Various Powers) Bill.

South Staffordshire Tramways.—The Bill will be allowed to proceed on condition that Tramways Nos. 1, 1A and 1B be struck out.

Macclesfield Tramways.—Allowed to proceed on condition that tramways Nos. 9, 10, 11, 12, 13A, 17 and 17A be struck out.

Gosport, Fareham and Cosham Tramways.—In this Bill the whole of the tramways sought to be constructed will have to be struck out unless the consents of the local and road authorities be proved.

South Lancashire Tramways.—The Bill will be allowed to proceed provided that Tramways 3 and 4 be struck out unless the consent of the Atherton Urban District Council be proved.

Tynemouth and District Tramways.—The Bill will be allowed to proceed on condition that the seven sections of tramway be struck out which are proposed in the Borough of Tynemouth. This will knock out nearly all the new lines proposed.

Wakefield and District Tramways.—To proceed on the understanding that No. 1 tramway be struck out unless the consent of the Ardsley East and West District Council is proved.

Manchester Southern Tramways (Cheshire).—The Standing Orders to be dispensed with providing that the necessary consents of the road authorities to tramways Nos. 1, 2 and 3 be proved. These tramways are in the districts of Ashton-upon-Mersey, Sale, Northenden, Gatley and Timperley.

Manchester Southern Tramways (Lancashire)—The Bill will be allowed to proceed providing that the necessary consents in the districts proposed to be traversed by Tramways Nos. 1, 2, 7, 8 and 9 are proved.

Coventry Electric Tramways.—The National Telephone Co. have withdrawn their opposition to this Bill.

Chard Corporation Gas and Electricity.—Opposition having been withdrawn, this Bill will go before Earl Morley's Committee on Unopposed Bills.

Hove, Worthing and District Tramways.—To proceed on the understanding that tramways 1, 2, 3, 4, 11, 12, 15, 16, 17 and 18 be struck out.

Hammersmith, City and North-East London Railway.—The Standing Orders will not be dispensed with, and the Bill will not be allowed to proceed.

Beckenham U.D.C. Bill.—The U.D.C. is petitioning for additional provision to enable lands to be acquired, so the Bill will go before the Standing Orders Committee.

Wigan Corporation Tramways.—An application having been made for an additional petition to enable the tramways to be constructed on a gauge of 4 ft. 8½ in. instead of 3 ft. 6 in. the Standing Orders were formally found not to have been complied with.

North-Western Electricity and Power Gas.—The Standing Orders Committee of the House of Lords have decided that Standing Orders may be dispensed with to allow of the promoters of the Shropshire, Worcestershire and East Derbyshire Electric Power Bill opposing this Bill.

In the Commons on 23rd inst. the London County Council (Tramways and Improvements) Bill passed second reading, but on 31st inst. a motion will be moved for an instruction to reject the clauses respecting the making of a tramway from Waterloo Bridge, along the Embankment, and over Westminster Bridge. We hope that the Commons will adopt a more enlightened policy than was adopted last year, and reject the instruction proposal.

In the House of Lords on 23rd inst. the Macclesfield and District Electric Tramways Bill was read a second time. In the Commons the Croydon and District Electric Tramways Bill, South Shields, Sunderland and District Tramways Bill, and Wellingborough and District Tramroads Bill were read a second time.

In the House of Lords on March 19th Lord Wolverton moved the second reading of the Electric Lighting (London) Bill. He explained that it was an attempt to make the present electric lighting areas coincide with those of the local authorities where the boundaries had been altered under the Local Government Act of 1899. In the event of disputes arising the Board of Trade were prepared to call a conference which might save their lordships from the trouble of appointing a Select Committee. The Bill was read a second time.

The daily press says that the L.C.C. Parliamentary Committee have been in communication with the Board of Trade with regard to the London County Council (Electric Supply) Bill, and they have been informed that the Government are of opinion that the matters included in the Bill are not such as should be made the subject of private legislation applying to London only, but should be dealt with in a public Bill affecting the whole country. The Committee understands that the Government will oppose the second reading of the Council's Bill, but will themselves bring in a public Bill on the subject as soon as practicable, and the Board has intimated its willingness to receive either a deputation from the Council, or written representations with regard to the provisions of the Bill to be put forward by the Government. In these circumstances the Committee recommend that the Council's Bill be not further proceeded with, and that the local authorities be informed of the reasons for its withdrawal.

Tube Bills.—The following Bills have been formed into a group and are being considered by a Select Committee of the House of Commons:—Baker Street and Waterloo Railway (Transfer); Charing Cross, Euston and Hampstead Railway; City and North-East Suburban Electric Railway; Great Northern, Piccadilly and Brompton Railway (Various Powers); City and South London Railway; and the London, Tilbury and Southend Railway.

Blast-Furnace Gas Engines.—Messrs. Cochrane and Co., Ltd., of the Ormesby Ironworks, Middlesbrough, who, some time ago, put down at their works a gas blowing engine of 600 H.P., working on furnace gases, are so satisfied with this type of engine that they have just placed an order for a gas engine to drive a dynamo. The gas engine, which is to be of the Cockerill type, and built by Messrs. Richardson, Westgarth & Co., Ltd., of Middlesbrough, is to be a horizontal double-acting engine having two double-acting cylinders, one behind the other, acting on one crank, and capable of 800 B.H.P. when running at a speed of 120 revolutions per minute. The dynamo, supplied by Messrs. Warren, Beattie and Co., Ltd., of Middlesbrough, is to be direct coupled to the crank-shaft of the engine, and will be a compound-wound continuous current machine having an output of 540 KW. It will run at 240 volts, have 16 poles, and weigh 30 tons, the armature alone weighing 12½ tons. When installed, this set will be one of the first, and certainly the largest, of this type of gas engine used in this country for generating electricity.

Heathman's Ladders.—A six-section ladder tower, rising to 54 ft. and closing to 12 ft. high, has just been completed for an order by Heathman & Co., of Parson's Green, S.W. The firm has supplied an improved arc-lamp wheeled ladder to Fulham Electricity Works.

Colliery Pumping Plants.—Messrs. Ernest Scott and Mountain, Ltd., have just secured a contract from Messrs. Bolckow Vaughan & Co. for a complete plant for main shaft pumping for their Dean and Chapter colliery, which has recently been sunk and is now being equipped. The plant will consist of a Scott & Mountain three-crank compound engine of the enclosed type with forced lubrication, of 420 H.P., direct-coupled to a three-phase generator wound for a tension of 500 volts per phase. The current from the generator will be conveyed down the shaft by means of three-core armoured cables to the pumps which will deliver 500 gallons per minute against a head of 400 ft., but the engine and generator will have a capacity equal to three pumps of this size, as it is proposed later to increase the pumping capacity as required. The pumps will be of the Scott & Mountain horizontal three-throw mining type, and similar to the pumps which they have installed at many mines in this country. The same firm have recently completed a large pumping plant for the Frodingham Iron and Steel Co. to deliver 750 gallons per minute from the River

Trent to the Steel Works. They have also in hand for the Ocean Coal Co. what will probably be the largest pumping plant in the kingdom to deliver 500 gallons per minute, or 30,000 gallons per hour against a head of 1,500 ft. For the South Wales Anthracite Collieries, Messrs. Scott & Mountain are installing a complete electric pumping and hauling installation, and they have also recently completed for the Tredegar Coal and Iron Co. for their Maclaren Colliery, Nos. 1 and 2 Pochin Colliery, Tryst Colliery, and Bedwellty Colliery, complete hauling and pumping installations for the whole of these collieries.

Willans Engines.—The Wholesale Co-operative Society, of Silvertown, have decided to instal two 100-H.P. Willans central-valve engines for direct coupling to dynamos of Messrs. J. H. Holmes and Co.'s make. Messrs. Dick, Kerr & Co. have sub-let the order for an 825 H.P. engine for direct coupling to their dynamos for Stepney electricity works, to Messrs. Willans & Robinson. The Cleveland and Durham County Electric Power Co. have decided to instal two 500-H.P. Willans central-valve engines for direct coupling to alternators of the Westinghouse Co.'s make.

Henley's New Works.—About 30 acres of land at Greenhithe (Kent) have been purchased for the erection of new cable works by the Henley Telegraph Works Co., Ltd., of Woolwich.

Catalogues and Lists.—Messrs. Millington and Everitt, of King's Parade, Cambridge, have issued a list of portable accumulators for ignition purposes.

Messrs. Royce, Ltd., of Manchester, have brought out Section III. of their excellent pamphlets. It contains illustrations, particulars and prices of motor starting switches and resistances.

A new and useful catalogue of ejector condensers has been published by Messrs. Korting Bros., of Westminster. It contains particulars of their new pattern balanced non-return valves, and of the automatic free exhaust valves which they are now manufacturing.

Price list No. 9 of the Electrical Co., Ltd., contains illustrations, prices and certain tabulated particulars of knife switches, high tension switches and automatic circuit breakers.

A number of neat lists of arc lamps, enclosed, semi-enclosed, and "new" types have been issued by the Brockie-Pell Arc Lamp, Ltd.

Messrs. H. T. Boothroyd, Hyslop & Co., of Rimrose Works, Akenside Street, Bootle, have issued a new price list of electric lighting plants suitable for ship's use. The pamphlet opens with a list of firms and ships where their plants are being used. The S type direct-coupled and belt-driven continuous-current multipolar generators are well shown, also high speed vertical steam engines for dynamo driving, electric lifts, winches, and a watertight motor. The plants are supplied in all standard sizes.

A leaflet relating to the Dalton cold lacquers for metals has come to hand from the Dalton Manufacturing Co., of 8, St. James's Square, Manchester.

Messrs. Griffiths Bros. & Co., of Bermondsey, have issued a new list of their specialities for electrical engineers. "Anti-sulphuric" enamel for battery room work, "Armacel" insulating varnish, "Armalac" insulating composition, and various varnishes and paints for electrical and engineering work are included.

A number of illustrated price lists have come to hand from Messrs. J. P. Hall & Co., of Oldham. No. 17 relates to their combined single-cylinder steam engines and multipolar dynamos; No. 18 is devoted to multipolar semi-enclosed shunt-wound motors; No 19 details four-pole series-wound reversing motors; and No. 20 is a 36 pp. list of multipolar dynamos, giving much tabulated data respecting the firm's four and six-pole open type machines.

An excellent lift catalogue, well bound and beautifully illustrated, has been brought out by Messrs. Wm. Aug's Gibson, Ltd., who, as we recently showed, are now manufacturing hydraulic and electric lifts at Glasgow, and have offices at 23, Fleet Street, E.C. Some capital photos. are given showing the different departments at the works, and there are many first-class pictures, accompanied with some general particulars of low and high pressure hydraulic passenger and goods lifts, direct-acting platform lifts, electric passenger lift equipments of the standard drum type, controller (rope control), lift controlled by switch in car, push button control; also hand-power warehouse lifts. We have no doubt that many of our readers will be anxious to obtain one of these catalogues, as being of interest to them in electrical installation work in factories, stores, and public buildings.

From Messrs. Marryat & Place, of Hatton Garden, E.C., we have received several leaflets of pumps and double helical wheels. The "Orvo" reciprocating pumps, without free movable valves, are meeting a demand in the market for a reliable pump of great simplicity with high speed, suitable for electric driving, but without the low suction heads and other drawbacks of centrifugal pumps. Some tables have been sent to us which show that the pumps are most suitable for electric driving. It is also claimed that as steam pumps with steam expansion gear and hydraulic power compensating device, the Orvo pumps are most economical. Another circular details the firm's double helical machine-cut gear wheels for traction reduction gear. The advantage of these wheels for single reduction gears lies in the fact that they work without backlash, and therefore with less noise than other spur gear. The special arrangement for double reductions up to 1:50 as a substitute for worm gears is said to save at least 10 per cent., and frequently 25 per cent. of the energy required. Copies of these lists will be sent to anyone interested, on application to the firm.

The Hart Accumulator Co., Ltd., has just issued a leaflet giving particulars of its special cells for motor-car ignition work. The cells can be supplied from stock either singly or in two or three compartment cases, which may be of ebonite or celluloid.

A very good list has been issued by Messrs. Holt & Willetts, of Cradley Heath. It forms the special lift section of their complete catalogue. They have purchased the business of Messrs. Thos. Thomas & Sons, of Cardiff, and Thomas's patent lifts have therefore been included in this section. Electric elevators for passenger and goods work are well shown by means of a number of excellent pictures, and they include direct coupled elevator lifts and warehouse cranes. The remaining contents of the catalogue are not electrical, but they comprise lifting apparatus for all kinds of places and purposes. At the end is given a list of a number of electric and power lifts recently supplied in different parts of the United Kingdom. The firm's London offices are at 112, Fenchurch Street, E.C.

Messrs. Verity's' new catalogue, of which a copy is now before us, consists of a collection of a number of their loose lists of electrical machinery caught together in convenient form allowing supplementary lists to be easily inserted. The lists show the Aston Lundell and "Aston Standard" motors, bipolar and multipolar dynamos, lighting fittings, fans for various positions, tramcar fittings, lamps, switches, wires and cables, motor starters, electric radiators, organ blowing machinery and a number of other special Verity lines.

A small list of Crypto ignition cell testers for motor bicycles and cars, and also showing the Crypto automatic cut-outs, has come to hand from the Crypto Works Co., Ltd.

A list of Boardman's electric arc lamps for portraiture, stage lighting and other purposes, has reached us from the Boardman Electrical Patents Co., Ltd., of Southwark Bridge Road, S.E.

Messrs. Geipel & Lange have placed before us a copy of their new catalogue of Vulcan measuring instruments as manufactured by Messrs. Chauvin & Arnoux, of Paris. Descriptions, with many illustrations, diagrams, and working instructions are given for a large variety of instruments, a number of them being portable sets which are now for the first time being brought before the notice of the electrical trade in this country. We understand that Messrs. Geipel hold a stock at Westminster of practically every instrument mentioned in the list.

American Patents.—Messrs. W. P. Thompson & Co., patent agents, of Liverpool, write:—"We have just received from a member of the United States Patent Committee an advance copy of an Act signed by President Roosevelt on March 4th, which has now become law. By this Act, the citizens or subjects of Great Britain, France, Spain, Italy, Portugal, Norway, Sweden, Denmark, Japan and Brazil can obtain 12 months' provisional protection for an invention in the United States by simply applying for a patent in any of their respective countries, or in almost any of the British Colonies. They are also now allowed to file caveats in the United States, entitling them to receive information if any person applies for a patent for a given invention which they may mention in their caveat. Lastly, that a foreign appointed executor or administrator may file an application for a patent in America for the invention of a deceased inventor without taking out ancillary letters of administration in America. This law has been passed in deference to the public opinion of the world, as, for a considerable period past, the United States, while obtaining similar privileges from other countries, and agreeing to give these privileges, did not give them, owing to there being no Act of Congress enabling the Patent Office to give such privileges. This difficulty has now been removed, and the law takes a past effect, so that any application made in any of the countries of the Union less than a year ago can now be protected in the United States, though otherwise the time for filing is past."

Carbon Contracts.—Contracts have been placed for "Fabius Henrion" carbons (by Mr. D. McNaughton, of 79, Mark Lane, E.C., who is sole agent for the United Kingdom) for the Liverpool Corporation and Hammersmith Borough Council; also an order for 100,000 ft. from a large engineering firm.

Books Received.—"Electrical Practice in Collieries," by Daniel Burns. London: Charles Griffin & Co., Ltd. 6s. net.

"Munro & Jamieson's Pocket-book of Electrical Rules and Tables." London: Charles Griffin & Co., Ltd. 8s. 6d.

"Experiments with Vacuum Tubes," by Sir David L. Salomons, Bart., M.A. London: Whittaker & Co.

"Telephone Lines," by Walter C. Owen. London: Whittaker and Co.

Imports and Exports of Electrical Machinery.—The imports of foreign electrical machinery into this country during February last reached a value of £65,664, as compared with only £62,137 in the preceding month. On the other hand, the exports of electrical machinery from this country during February last only reached a value of £33,652, as compared with £42,029 in the preceding month.

German Cable Works.—It is reported that a company is in course of formation in Hamburg for the purpose of establishing large new works for the manufacture of electric cables.

For Sale.—Messrs. P. Huddleston & Co. will sell at Hammersmith on April 2nd the stock and plant of an electrical engineer, and some particulars are given in our advertisement pages to-day.

Kirkcaldy Electricity Works.—In our article on these works last week we illustrated the two switchboards; the whole of the indicating instruments mounted on these were made by Messrs. Evershed & Vignoles, Ltd.

ELECTRIC LIGHT AND POWER NOTES.

Aberdeen.—The new electricity works for the Aberdeen Corporation, which have been in course of erection at Ferryhill since April, 1901, have now been practically completed, and on Friday, 20th inst., they were formally inspected by the members of the City Corporation. An interesting feature in connection with the works was the construction of an electric cable subway between the electricity station and Union Street, the principal thoroughfare of the city, by way of Crown Street, a distance of over 800 yards. The subway was constructed to carry all the feeder cables with their pilot leads for supplying the energy to the tramways, and for the distributing mains in the west, north, and central districts of the City. It has been designed to carry cables suitable for 10,000 H.P., and its average dimensions are 7 ft. 6 in. high by 4 ft. 6 in. wide. By means of this subway feeders can be easily inspected, additions and alterations made without interfering with the streets, and a very much lighter grade of insulation used on the cable than if buried in the ground. The members of the Corporation, at the outset of their inspection, entered the subway at the Union Street end and walked through it to the electricity works. The new establishment covers about 2½ acres of ground, and consists of a boiler house, engine room, battery room, economiser house, pump room, offices, stores and test room; also workmen's mess room and chimney stack. The boiler house is 137 ft. long by 82 ft. wide. In the centre there is an overhead coal hopper into which the coals are raised by means of electrically-driven elevators and conveyors. The boilers at present installed are six in number, and are of the Babcock & Wilcox type, fitted with superheaters and mechanical stokers. There are two Green economisers. The chimney stack is 210 ft. in height, with an internal diameter of 14 ft.

Over the economiser house is a water tank capable of holding about 60,000 gallons of water, which is used for condensing purposes. The water is pumped from the River Dee by centrifugal pumps.

In the pump room are two Weir pumps, each capable of delivering 4,000 gallons per hour. The engine room is 126 ft. long and 62 ft. wide. There are two engines of 300 H.P. each, coupled direct to Messrs. Mavor & Coulson's dynamos; one of 300 H.P., coupled to Messrs. D. Bruce Peebles & Co.'s dynamos; one of 700 H.P., coupled to a Johnson-Lundell dynamo; and one of 700 H.P., coupled to a Westinghouse dynamo. A few weeks ago the Corporation decided to instal another of 700 H.P. There is in the engine room a 120-KW. balancing set. The switchboard is fully equipped with the necessary instruments, mounted on marble panels.

The battery room contains two batteries of 128 cells each, together capable of giving a discharge of 2,200 ampere-hours at 440 volts. The batteries were supplied by the Electrical Power Storage Co., Ltd., of London. At one end of the battery room is a booster set for charging the batteries. At the present moment there is plant in the new works to the value of about £50,000, and the establishment altogether will cost the Corporation between £90,000 and £100,000.

At the close of the inspection of the works some interesting remarks were made by Councillor George Kemp, convener of the Gas and Electric Lighting Committee, regarding the rapid growth in the output of electricity since its manufacture was started by the Corporation in 1894. Whereas in the latter year the consumption was 71,921 units, up to date this year there had been produced 2,076,019, or, with 7½ months of the year gone, within 300,000 of the estimate for the whole year. There were now 1,075 consumers, 118,731 8-C.P. lamps, representing an increase for the 7½ months of the present year of 17,258. The number of motors, private and hired out, was now 278, representing 1,078 H.P. The public and private arc lamps number 618. The new works are so constructed that when it is found necessary to do so, the Corporation can double them without taking down a single stone or brick of the present structure. The electric cable subway already referred to has saved the Corporation a sum of £3,000 in 18 months by using less expensive cable and in the avoidance of street opening for repairs, &c. The cost of the cable subway had been £8,400, and at the present moment it contained 30 cables.

The new electricity works were erected under the supervision of Mr. J. A. Bell, electrical engineer for the Corporation, to plans prepared by Mr. Samuel Milne, assistant gas engineer for the city.

Arbroath.—The E.L. Committee, having received an intimation from the B. of T. as to revoking the prov. order, is considering several proposals by interested companies for leasing the same.

Birmingham.—A L.G.B. inquiry was held last week into the application of the City Council for power to borrow £29,732 for extensions of the electric lighting undertaking, divided as follows:—Estimated cost of extension of the works at Water Street station, £11,500; amount of over-spent capital on estimate for works not originally contemplated, £8,782; additional expenditure on mains and services for which no provision was made in the previous application, £4,449; services and street works for future extensions, £3,000; provision of meters for future extensions, £2,000. Previous loans of £500,000 for the purchase of the undertaking, and £251,974 for extensions, had been sanctioned. Included in the loan of £251,974 was a sum of £128,890 for the erection of a generating station on a site acquired for that purpose in Summer Lane, largely in anticipation of a probably early demand for electric energy for tramway purposes. The unsettled condition of the tramways question in Birmingham, however, had led the City Council to decide not to embark immediately on the erection of that large station. At the present rate of increase the ordinary growth of the department could be provided for for 1903, and probably for 1904, by a comparatively small extension of the plant at the existing Water Street station. The city electrical engineer, Mr. Vaudrey, gave evidence as to the details of the loan.

Bradford.—The Electricity Committee has approved a proposal to borrow £217,000 more for extensions and plant at the electricity works.

Caerphilly and Bedwellty.—A B. of T. inquiry was held on March 18th into the application of the local authorities for electric lighting powers. Vigorous opposition was offered in both cases. The estimated cost of the Caerphilly scheme is £10,000, and that of the Bedwellty scheme, £7,000.

Cardiff.—The Board of Guardians has obtained from the Corporation electrical engineer (Mr. A. Ellis) an estimate for installing the electric light in the workhouse. The capital cost of installing 776 lights, including mains and fittings, would be £1,164. Compared with gas lighting, electricity would effect a saving of £11 per annum.

Colne.—The T.C. has fixed the price of energy for motors at 3d. per unit for the first hour and 1d. afterwards, or an alternative flat rate of 2½d. per unit.

Colwyn Bay.—The D.C. has received the sanction of the Local Government Board to the borrowing of £2,680 for new plant.

Dewsbury.—The new engine and plant put down at the electricity works to enable the Corporation to supply power to the British Electric Traction Co. were set in motion on Tuesday last week by the Mayor. The steam-raising plant now consists of three Lancashire boilers, 28 ft. × 7 ft., working at 150 lbs. per sq. in., and fired by Bennis stokers. The generating sets consist of seven Willans engines coupled to various types of dynamo. The lighting and tramway switchboards are entirely separate, although some of the machines can be used for either purpose. The accumulators are used for lighting purposes only. At the rear of the works is the cooling tower, a new erection which stands on brick piers built in a reservoir 60 ft. × 25 ft. The cooler is capable of cooling 30,000 gallons of water per hour. After the new plant had been set in motion, members and officials of the Corporation were entertained to tea by the chairman of the Electricity Committee (Alderman A. Oldroyd).

Dover.—In a report to the T.C., Mr. E. Manville states that he is of opinion that the Electric Lighting Co.'s undertaking is worth the £142,228 which the Corporation has agreed to pay.

Dumfries.—At a special meeting of the T.C. on Monday, the correspondence with Messrs. Crompton & Co., London, was read with regard to their offer to take up the prov. order and carry through the electric lighting of the town. They had offered the town the option of purchasing at the end of 14 years on a valuation, or, to avoid arbitration, on repayment of their capital outlay, and 10 per cent. per annum added, less the amount of profit earned. In another letter they stated they would be prepared to allow the Council the option of a transfer at the lapse of eight years on the same terms. The Council decided to decline the company's offer, and notice of motion was thereafter given to take a plebiscite on the whole question of electric lighting.

East London (Cape Colony).—Mr. E. G. Jones, retiring borough electrical engineer, recently reported that the old overhead high pressure mains were being adapted for magnetic switches, which will enable all the street incandescent lamps to be switched off and on the power station.

Evesham.—The T.C. on Monday decided not to take any further steps at present with regard to electric lighting.

Exmouth.—The B. of T. have informed the U.D.C. that they will defer the revocation of the electric lighting order for one year from May 25th next.

Faversham.—The T.C. has received from the L.G.B. sanction to borrow £23,779 for the purpose of constructing electric light works. It is proposed to erect several arc lamps, and 112 other public lamps of 16 C.P. each.

France.—The Elsässische Maschinenfabrik, of Mulhouse, have lately completed two 600-H.P. tandem gas engines on the Delamare-Debouttéville system for the Chotillon and Commentry Co., at Neuves-Maisons. The engines are intended to utilise the waste gases of the blast furnaces, and will be employed for electric lighting purposes.

Gillingham.—The D.C. has resolved to lay down new mains for the supply of electric current to the new Royal Naval Hospital at New Brompton for the Admiralty and new mains for street lighting and business purposes. The E.L. Committee has recommended the Council to charge 6d. per B.T. unit for energy supplied through slot meters.

Glasgow.—A special sub-committee having, under the remit to it by the Electricity Committee of the T.C. on January 9th last, considered the report then submitted by the engineer as to charges for a continuous use of electric energy, and the terms upon which he would be prepared to recommend supplies of electrical energy to be given for power purposes, has made the following recommendations, viz.:—That long-hour consumers of energy for power purposes be supplied with demand indicators, and be charged at the rate of 1½d. per unit for the first 1,277 hours' use per annum of their respective maximum demand quantities as recorded during the months of November, December, and January only, and for all further quantities at the rate of ¾d. per unit; that any consumer of energy for power who may desire it shall, for an annual rental of £2, be supplied with an automatic clock switch which will cut the demand indicator out of circuit at all times, except during the 2½ hours between 3.30 p.m. and 6 o'clock p.m., during the months of November, December, and January; that, notwithstanding the rates per unit and arrangement mentioned in the two preceding recommendations, no consumer shall be charged less than an average price of 1d. per unit for the energy consumed during the whole year; and that the new arrangement now proposed should come into operation as at June 1st next. Extensions of the lighting mains are to be carried out at a total estimated cost of £6,250.

Grimsby.—The E.L. Committee has adopted suggestions of Mr. Vignoles, the borough electrical engineer, for the reduction of the price of electrical energy for power to the following scale:—For the first 100 units per horse-power of motor per annum, 2½d.; for the next 1,500 units, 1½d.; for the next 1,000, 1¼d.; above 2,600 units, 1¼d.; with cash discounts. It has been resolved also to make an extension of the cables in various parts of the town at an estimated cost of £2,510.

Kingston-on-Thames.—The T.C. has received a report from Mr. H. R. J. Burstall relative to the electricity undertaking. He favours a charge of 8d. per unit for the first hour, and 3d. after, with 3d. per unit for power; and the extension of street lighting with small arc and Nernst lamps. He recommends that the provision of a third set of 300 KW. should be deferred until after next winter, owing to the slow growth of the demand. The single-phase alternating-current system is to be retained, although future extensions should be on the three-wire system. The cost of production is too high, owing to long running at light load, and uneconomical boilers, &c. This could be obviated by installing a battery, but the saving would be small. More saving could be effected by specially arranging for the light load plant to run with a maximum economy. To make the installation a paying concern, it is necessary to incur as little capital cost as possible in the immediate future.

Leeds.—The T.C. has decided to apply to the L.G.B. for a loan of £220,000 for electric light extensions.

Leicester.—The result of the half-year's working of the electric lighting department of the Leicester Corporation, shows a profit of £2,686 13s. 2d., after paying interest on capital, and £2,545 10s. 1d. on account of the sinking fund. The profit for the half-year ending June last was £2,017 13s. 2d., which makes a total profit for the year of £4,704 6s. 4d., an increase of 15 per cent. compared with the previous year.

Liverpool.—The E.L. Committee has decided to light James Street with electric arc lamps at an estimated outlay of £1,000.

London.—ST. PANCRAS.—The B.C. meeting on Wednesday, the 18th inst., passed schemes for lighting 37 thoroughfares by 97 arc lamps at an estimated cost of £14,702. It was resolved to obtain further condensing plant at an estimated cost of £1,900, and to provide additional store room at the King's Road works, at an estimated cost of £316. The Committee had unsuccessfully negotiated with the object of using oil for fuel, and therefore decided to fit the new boilers for coal firing.

BERMONDSEY.—The net surplus for the first nine months' working of the E.L. undertaking was £252. The business done far exceeded expectations, the load being practically even for the whole of the day. The second year's profit is estimated at £1,700.

ISLINGTON.—The E.L. Committee has received a letter from the L.C.C. to the effect that, until the passing into law of a Bill providing for the re-adjustment of electric lighting areas so as to make them co-terminous with the respective borough boundaries, loans for works in transferred areas would not be sanctioned.

CAMBERWELL.—The report of the representatives appointed by the B.C. in reference to the application of the London Electric Supply Corporation for an extension of its order to cover the whole borough was issued on Saturday, the 21st inst. The B. of T. is not disposed to recommend that the clause to enable the Borough Council to purchase the undertaking at any time before the expiration of 42 years be allowed to remain in the order. The representatives, being of opinion that it is desirable there should be competition in electric supply, recommend the Council to inform the B. of T. that they approve of the application of the London Electric Supply Corporation, even without the purchase clause.

HAMPSTEAD.—The B.C. estimates the capital expenditure on the electric light undertaking for the year ending March 31st, 1904, at £19,178.

L.C.C.—The Finance Committee reported at Tuesday's meeting of the Council that at the request of the Marylebone M.B.C. it had provisionally included in the Money Bill of 1903 a sum of £1,440,000 for the purchase of the Marylebone undertaking of the Metropolitan Electric Supply Co., and for new works in connection therewith.

It appeared from a report by the Highways Committee that the B. of T. has decided not to proceed with the application of the Bermondsey M.B.C. for a prov. order in respect of the parishes of St John, Horselydown, St. Olave and St. Thomas, which now form part of the borough of Bermondsey.

The B. of T. has informed the Parliamentary Committee that the Government were of opinion that the matters included in the L.C.C. (Electric Supply) Bill were not such as should be made the subject of private legislation applying to London only, but should be dealt with in a public Bill affecting the whole country. The Government intended to oppose the second reading of the Council's Bill, but would bring in a public Bill on the subject as soon as practicable, and the B. of T. had intimated its willingness to receive either a deputation from the Council or written representations with regard to the Bill to be put forward by the Government. Under the circumstances, the Committee decided to withdraw the Council's Bill.

HACKNEY.—The E.L. Committee of the M.B.C. reported this week that manufacturers generally were not prepared to lay out a large amount for the purchase of motors. This was the greatest obstacle in the way of electrical power being used instead of gas, steam, &c. The Rhodes Electrical Manufacturing Co. was prepared to enter into an agreement to supply and fix motors on consumers' premises at schedule rates on the hire-purchase system. The Committee had decided in favour of this offer being accepted for seven years, with the option of the Council to determine at the end of the third or fifth year.

Macclesfield.—The Corporation's electric light order expires in July next, and the B. of T. have informed the T.C. that if it is able to satisfy them that it proposes to carry out its obligations, they will consider whether revocation of the order shall be postponed or not.

Manchester.—At the last meeting of City Council, Dr. Kennedy's report as to the status of the electricity department was adopted, and in pursuance of his recommendation that the sale of electricity should be fostered and encouraged, it was decided to reduce the price of energy for motive power by ½d. per unit, making the charge 1d. per unit to consumers using their maximum demand for 48 hours and upwards per week. Mr. Howarth, chairman of the Electricity Committee, intimated that a further step would soon be taken, and a proposal to purchase motors for hire would be laid before the Council. The conclusion arrived at, as the result of the recent investigation, Mr. Howarth said, was that, with the plant now in course of erection, sufficient power would be available to meet the probable demand for some years to come. Dr. Kennedy's report had met with the entire concurrence of the Committee. Replying to a question as to how it was that whilst Liverpool, with a capital outlay of £1,200,000, had supplied 20 million units, Manchester had only supplied half that quantity on a capital outlay of 2 millions sterling, Mr. Howarth pointed out that the Liverpool tramways had been working for a very much longer period than those of Manchester. The Manchester Corporation had been compelled to provide, at great expense, machinery for a tramway undertaking that was not developed, and the past year had been to a great extent unproductive. Much better results would be shown when the full number of cars were in use.

Mansfield.—The Corporation is making satisfactory progress with the electricity works, and it is expected that current will be available for both lighting and power on May 1st.

Milford-on-Sea.—A scheme is being promoted locally to form a company for the supply of electricity in the town and district.

Nottingham.—The new infirmary and workhouse, which was opened on the 18th inst, is provided with a complete lighting and power plant, consisting of two 125-KW., and one 30-KW. Willans-Laurence Scott generating sets. The exhaust from the engines is taken through a grease separator to the heating system. The dynamos are compound-wound and connected to an equaliser bar for parallel working. The mains are "B.I.W." lead sheathed, and protected in Howard asphalte troughs where carried across the grounds to the various blocks. There are about 2,700 lights distributed throughout the buildings, and the laundry is electrically driven. The cost of the lighting plant and installation was about £10,000; the work was carried out by Messrs. G. H. Woods, Slacke and Co., of Blackburn, to the specification of Mr. David Stevenson, Westminster.

Paignton.—The owning company having refused to sign a transfer of the prov. order to the U.D.C., the latter body has taken counsel's opinion on the matter. This opinion states that the agreement was not really necessary, the payment of £200 being quite sufficient under the B. of T. order.

Pudsey.—A joint committee has been appointed by the T.C. to inquire into the advisability of combining a refuse destructor with the electric lighting station.

St. Annes.—The U.D.C. has received from the L.G.B. sanction to borrow £15,023 for the provision of additional plant for supplying energy to the new Blackpool, St. Annes, and Lytham tramways.

St. Helens (Isle of Wight).—The Isle of Wight Electric Light Co. has offered to light the whole of the U.D.C.'s district with electricity at £2 7s. 6d. per lamp per annum, against £2 9s. 3d. at present charged for gas.

Seulcoates.—The Board of Guardians has received from the L.G.B. sanction to borrow £1,900 for the purpose of lighting the workhouse and infirmary by electricity.

Scottish Midland Power Scheme.—A power scheme is proposed for Central Scotland. It is intended to supply electrical energy within the counties of Linlithgow and Clackmannan, the greater part of Stirlingshire, and the parish of Cumbernauld, in Dumbartonshire, the district scheduled being one of the most thriving industrial areas in Scotland. Generating stations are proposed to be erected between Alloa and Menstrie, at Bonnybridge, and at Westfield station, in Linlithgowshire. The engineers for the scheme are Messrs. Bramwell & Harris, 5, Great George Street, Westminster, S.W., and the solicitors are Messrs. Davidson and Syme, 28, Charlotte Square, Edinburgh.

Sevenoaks.—The 1900 electric lighting order has been revoked.

Southampton.—The report on the past year's working of the Corporation E.L. works shows that a profit of £4,328 has been made. The E.C. recommends that after March 31st new consumers shall be supplied at a flat rate of 5½d. per unit for lighting, and that present consumers be given the option of the same rate after the end of the March to June quarter.

West Bromwich.—The Electric Lighting and Power Committee of the Corporation in a report issued this week recommends the extension of the generating plant at an estimated outlay of £9,000, together with a further £900, the cost of extensions of mains, services, &c.

ELECTRIC TRACTION NOTES.

Berlin Railways.—At a meeting of the Railroad Science Association in Berlin, Mr. Bork, Privy Commissioner of the Royal Railway Board, lectured on the future of electric main line traffic. He observed (writes the Berlin correspondent of *Commercial Intelligence*) that experiments during the past two years over the Wannsee line had fully established that electricity could compete with steam, and, indeed, under certain conditions, outstrip it. The great advantage of electricity consisted in its allowing the train units to be easily altered according to the demands of traffic. The lecturer concluded with the announcement that as a result of the experiments it has been determined to use electricity over the Berlin-Gross Lichterfeld line, and that trial trips will be made in April.

Birkdale.—Major Druitt, Board of Trade inspector, inspected the signalling apparatus over the railway line at the Laughton Road level crossing on Saturday, and it has been decided to institute a quarter-hour service of cars from the Crown Hotel, Birkdale, to Southport. Amongst those present at the inspection were Mr. Raworth and Mr. Colebourne, chairman and secretary of the Tramway Co.; Mr. Worthington, engineer to the L. & Y. Rly. Co.; Mr. Betham (chairman of the Tramways Committee of the Birkdale District Council); Mr. Lloyd, local manager of the company, &c.

Black Country.—On Wednesday and Thursday last week the Light Railway Commissioners held an inquiry at Old Hill, with reference to applications made for orders authorising the construction of tramways in the Quarry Bank, Brierley Hill, Rowley Regis, Dudley and Halesowen districts. All the local authorities through which the lines would pass were represented at the inquiry. Mr. Parfitt, for the promoters, addressed the Commissioners with respect to the scheme known as the Quarry Bank, Brierley Hill and Rowley Regis Light Railways. Official evidence was given in support of the scheme, and with a view to show that tramways were absolutely necessary to assist in the development of the district named, as well as for the convenience of all classes of the community. The Commissioners afterwards proceeded to hear evidence in support of the applications by the British Electric Traction Co. Mr. Stephen Sellon, the engineer to the company, gave details of these schemes, but after his and other evidence, however, the company decided to withdraw their application, and the Commissioners then approved of a joint scheme for constructing a tramway from Brierley Hill to Cradley Heath, by the Brierley Hill, Quarry Bank and Rowley Regis District Councils. The Commissioners, on the other hand, refused the application by the Rowley Council to construct various light railways within their own district.

Cheadle.—An electric tramway is about to be laid from the borough of Stockport to Gatley, in the urban district of Cheadle, at an estimated cost of £19,700. The work will be done by the District Council of Cheadle, but the traffic will be worked by the Stockport Corporation, the District Council being eventually reimbursed for its outlay. Application is to be made to the L.G.B. for borrowing powers.

Coventry.—At Birmingham Assizes last week a builder sued the Coventry Electric Tramways Co. for damages for personal injuries sustained in a collision. The jury awarded him £500 damages.

Croydon.—The residents in Upper Norwood who once strenuously opposed the construction of electric tramways in the borough, are now anxious for the B.E.T. Co.'s lines to be extended there.

District Railway.—A *Times* correspondent says that the first two trains built in connection with the electrification of the Metropolitan District Railway have been recently delivered to the company, and are now at South Harrow, where they are being fitted with their electrical equipment before being worked in a series of trial trips over the new section of railway between that place and Ealing. This line, though it has been completed for about two years, has not been opened to the public, and it is now being used as a sort of training ground in connection with the electrification, a small power station having been built to supply the electric current, as the main station at Chelsea is still far from complete.

Furness Railway and Electric Traction.—Speaking at Barrow on 18th inst., Mr. Aslett, the general manager of the Furness Railway Co., said that his company was considering the question of tapping Lake Windermere with a view to electrical traction experiments on the Lakeside branch of the line.

Huddersfield.—The borough engineer, Mr. K. F. Campbell, has been instructed to try the Thermit rail joint.

The right of carrying parcels on the tramcars has been granted to the Yorkshire Tramways Parcel Express Syndicate for £600 per annum, or one-third of the total receipts for the carrying of such parcels whichever sum shall be greater.

The tramway receipts for the month of February amounted to £4,114 (9·09d. per mile), which is an increase of £954 upon the corresponding month last year.

At the meeting of the City Borough Council on March 18th the Tramways Committee submitted a lengthy report setting forth the duties of the borough engineer as to tramways reconstruction, the cost of the borough engineer's department, the actual cost of the work of conversion of the system from steam to electric haulage, and comparative statements as to the cost of similar works in other towns. The total value of the work supervised by the borough engineer is as under:—

	Total.	Per mile.
1. Permanent way, 27½ miles..	111,458	4,055
* 2. Overhead equipment, 35½ miles	32,741	928
† 3. Cables, conduits, &c.	31,863	903
4. Station buildings, plant, &c.	50,774	1,440
5. Cars	31,720	900
	£258,556	

* The cost of overhead equipment for the first half was £1,133 per mile, for second half £780 per mile.

† This includes spare conduits laid whilst trenches were open to serve future extensions.

The cost of work executed outside the borough at Linthwaite and Honley was £12,114. The Committee added that:—

Whilst appreciating very fully the value of the services rendered by the borough engineer in the work of conversion and reconstruction, and the excellence and economy of the general results obtained, we regret that we cannot, in the present financial position of the undertaking, recommend that any extra remuneration whatever be granted to him for work done within the borough. But construction work outside the borough should be considered from a different standpoint, and we recommend that a commission of 2½ per cent. (being half the usual professional charge for such work) be paid to the borough engineer upon the actual cost of the work done at Linthwaite and Honley, and that such sum be added to the capital expenditure upon those sections.

The borough engineer had applied for a grant of 1,000 guineas in consideration of the extra work done by him in the conversion of the system to electric traction. Owing, however, to the possibility of opposition to the grant in view of the present financial position of the borough, the chairman of the Tramways Committee (Mr. T. H. Moore) withdrew the Committee's recommendation and the engineer's application.

London.—Addressing the shareholders of the Crystal Palace Co. on Friday last at the annual meeting, Mr. Ernest Schenk, the chairman, devoted a considerable portion of his speech to the necessity for increasing the travelling facilities to and from the Palace. He said he did not think the railway companies could much longer delay the electrification of their suburban systems by which alone they would be able to give a cheaper, faster, and above all, more frequent service, which daily became a more pressing necessity to the districts they served. The electrification of London and suburban tramways had been a painfully slow process, retarded by a hopeless tangle of legislation which instead of facilitating the introduction of tramway facilities, had, on the contrary, thrown every conceivable obstacle in their way. He felt sure, however, that the great change which had lately come over public opinion in regard to electric traction was having its effect with the authorities, and that just as the inaccessible wilds of West London had been transformed by the introduction of a splendid system of electric trams, so the barriers that had hitherto cut off the Crystal Palace from the great system of South London tramways would very shortly be broken down, and whether the trams were constructed by municipal or private enterprise, they would see some astonishing traffic figures in the very first year they

were running. He referred once more to that all-important question, as he felt that until by means of new traffic facilities they could obtain a substantial increase in their revenue, they as a company could not look for a material further improvement in any other direction.

Southwark.—An announcement was made at last week's B.C. meeting that the L.C.C. would shortly commence the work of electrifying the Kent Road tramways opposite Page's Walk continuing northwards, and thence along the New Kent Road to the Elephant and Castle.

Greenwich.—The Borough Council last week raised objections to the cast-iron feeder pillars proposed to be erected on the footways by the L.C.C. in connection with the scheme for the electrification of the tramways. It was decided to write pointing out the inconvenience and danger likely to be caused to pedestrians, and suggesting that the pillars be either placed underground or erected in private forecourt grounds.

Wandsworth.—The Borough Council is asking the Highways Committee of the L.C.C. to proceed as speedily as possible with the construction of the tramway in Garratt Lane. The Borough Council is of opinion that the line is one on which the overhead system of electrical traction might with advantage be adopted.

The Traction Co. of the United Kingdom, Ltd., has acquired a controlling interest in the London, Camberwell and Dulwich Tramways Co. A scheme to relay and electrically equip the whole of the track is being prepared.

Manchester.—The matters in dispute between the Corporation and the Manchester Carriage and Tramways Co., with regard to such of the old tramways as belonged to the latter before the electrification of the system, seem to be on the eve of settlement. Protracted litigation was threatened. Consultations have recently taken place between representatives of the parties and their leading counsel in London, but the result has not yet been made known. It is believed, however, that progress has been made in the direction of an understanding.

Middlesex.—The Light Railway Commissioners have submitted to the B. of T. for confirmation an order authorising the Middlesex County Council to take lands for widening roads on which light railways will be laid in the parishes of Edgware, Finchley, Friern Barnet, Hendon, Kingsbury, Little Stanmore, Southgate, Tottenham, Willesden, and Wood Green.

Newcastle-on-Tyne.—At the meeting of the City Council on the 18th inst. the estimates for the tramways were considered. The estimsted expenditure for the year was put down at £160,851 as against £41,860 for last year, and the estimated income was £167,650. The chairman of the Committee (Mr. Cail) said the traffic receipts were estimated at £3,150 per week, or £163,800 per year, and they would receive from the Watch Committee for lighting £3,000. The working expenses were put down at £93,600. The Committee resolved to put down £15,000 for renewals, but they had referred it back to the General Purposes Committee, and the figures put before that Committee tended to show that that sum would not be sufficient, and the General Purposes Committee, on behalf of the Tramways Committee, asked the Council and the Finance Committee not to deal with the estimated surplus of £29,000 until the end of the financial year. This view was opposed, and some members suggested that the balance should be utilised in reducing the rates, after adequate allowance had been made for renewals. Sir Charles Hamond moved that the report be sent back as he did not want the town to be saddled with a tramway rate. Alderman Newton seconded, and Mr. Cail having assented, the estimate was referred back to the Tramway Committee.

Peterborough.—Another section of the electric tramways was completed on Saturday when the first car ran through to Newark. Mr. G. W. Shackleton, engineer for the permanent way and overhead construction, represented the contractors, Messrs. J. G. White & Co.

Surface Contact Tramways.—A paper on this subject was read last week at the Midland Institute, Birmingham, before the local association of Civil Engineers, by M. Victor Bornand, an engineer who until lately was engaged in designing and carrying out surface-contact tramway systems in Paris.

Sydney (N.S.W.).—A daily contemporary, in a summary of the report of the New South Wales Railway Commissioners for the quarter ended December 31st last, says that the tramways form an important State asset. For the quarter the earnings were £190,951, and the expenditure £167,915, showing increases of £32,783 and £30,411 respectively over the corresponding period of the previous year. The number of passenger journeys was 33,000,000. The tramways, principally under the electric system, aggregate 120 miles, and have proved a great public convenience, while entailing no burden on the State. The fares have been made low, the desire being to limit the financial return to meeting the interest annually due on the cost of construction.

Wolverhampton.—A special meeting of the Tramways Committee was held on Tuesday for the purpose of considering a report presented by the borough electrical engineer (Mr. C. E. Shawfield) on the working of the Lorain system of electric traction in the borough during the last 12 months. The report was a most exhaustive and important one. It dealt mainly in facts relating to cost of working, wear and tear of equipment, safety, &c.; and it was intended as a guide to the Committee and the Council in deciding whether the Lorain system of traction should be adopted permanently in the borough. A definite step in this matter must be taken by April 17th, and provision is made for the calling in of an arbitrator, if necessary. In this connection it may be worth while to reproduce here two clauses in the contract of the Corporation with the Lorain Co. which deal with the question of the "commercial success" of the system. These clauses are as follows:—

18. In case of any disagreement arising regarding the contract or the meaning of the term "commercial success," all such matters shall be settled by arbitration, the arbitrators consisting of five members, the first the borough electrical engineer of Wolverhampton, the second a party chosen by the borough electrical engineer, the third a representative of the contractors, the fourth a party chosen by the contractors, and the fifth a party nominated by the Board of Trade; each member to have equal voting power, and majority vote to be accepted by both parties and considered final. In the event of any failure on the part of the borough electrical engineer, or on the part of the contractors to choose or appoint any member or members of the said arbitrators to be appointed by him or them under the provisions thereof for the period of 14 days after notice requesting such choosing or appointment, shall have been given to him or them in writing, then the Board of Trade shall on request of either the contractors or Corporation appoint a member or members of said arbitrators to fill the vacancy or vacancies caused by such failure, and any member or members of said arbitrators so appointed shall have, possess, and be invested with all the powers and authority which he or they would have had possessed or been vested with had he or they been chosen or appointed by the person or party entitled to appoint him or them in the first instance, and for the purposes of this article the representative of the contractors in charge of the work unless the contractors shall otherwise order in writing delivered to the Corporation shall have power to select and appoint any member or members of said arbitrators to be appointed by the contractors and to give and receive any notice to be given or received hereunder and to make any request to be made hereunder.

19. In deciding whether the said system as applied to the said tramways is or is not a commercial success, the arbitrators shall take into consideration the question whether the system is safe and reliable, the consumption of electrical energy per car-mile, the cost of working and the cost of maintenance on the one hand, and compare that question and those items with similar questions and items in relation to an electric tramway worked on the overhead trolley system, after making equitable allowance for the additional apparatus required in the Lorain Steel Co.'s surface contact system, and also making equitable allowance for the difference in the cost of operation and maintenance between overhead and surface contact systems, it being understood that a surface contact system is more expensive in operation and maintenance than an overhead system; on the other, without regard to whether or not an actual profit shall have been made by the Corporation during the period of maintenance, and without regard to interest on capital or sinking fund.

We understand that from Mr. Shawfield's report it is estimated the 11 miles of single track now equipped with the Lorain system costs over £2,000 per year more to work than if the same length were equipped with the overhead system; and that if the entire length of line for which the Corporation have obtained Parliamentary powers were worked on the Lorain surface contact system, the extra cost would be between £6,000 and £7,000 a year over the cost of the overhead system. We understand further that Mr. Shawfield suggested that if the Lorain system be finally adopted, then the whole of the covers or surface of the Lorain contact boxes now in use should be taken up and replaced by a new surface before the Corporation accept responsibility for the working. It is claimed, we believe, that a better and more durable cover or surface for the boxes has been recently devised. It should be added that the Committee deliberated in private.

TELEGRAPH AND TELEPHONE NOTES.

Life on Fanning Island.—We have been favoured with a copy of the *Queenslander* for January 24th, in which there appears a short description of the Fanning Island station of the Pacific cable. A number of photographs are published of views of interest on the island, these photographs being taken by the Pacific Cable Board's chief electrician, Mr. J. Millward, late of the Eastern Telegraph Co. The total area of land is about 16 square miles, and the highest point is about 10 ft. above sea level, but there seems to be no fear of danger from tidal waves. Mr. Cuthbert is the superintendent at Fanning Island station, and he at present has a staff consisting of a clerk in charge, five clerks, two check clerks, a mechanician, and a battery man. One point of interest is that there are no roads on the island, and "our people will have to be content with walking round the verandahs as a means of exercise."

German Cable to America.—Reuter says that the laying of the second German cable from Emden to New York was begun on 23rd inst. at Emden.

Municipal Telephony.—An American opinion on this subject appeared in the issue of the *Electrical World and Engineer* which is just to hand. Our contemporary says:—"One of the papers presented at the recent municipal ownership convention in New York City, on the subject of municipal telephony in Great Britain, by Mr. A. R. Bennett, betrayed an extraordinary absence of financial common sense. And yet the word extraordinary seems rather out of place when we consider how common is the tendency of advocates and statisticians for municipal ownership to leave depreciation out of their estimates. In speaking of the Glasgow system and its financial year, Mr. Bennett remarks naively:—'No depreciation was allowed for, because the system was entirely new.' As if conscious that something is wrong, he goes on to say that a depreciation fund is to be created. The notion here exhibited as to the nature of depreciation and the purposes of a depreciation

fund does not give much weight to any of Mr. Bennett's other statements, which but for it might possibly be entertained with respect But it is easy to see how remarkable municipal economies may be arrived at by such free treatment of unavoidable items in the cost of telephone service. Only a week or two ago we had occasion to point out in regard to the electric lighting plant at Detroit that not merely did the Commissioners fix a very small rate of depreciation, say, 3 per cent., but they did not take into account the wholesale depreciation due to the substitution of new apparatus for old. This criticism is just as true of telephone exchanges in large cities, which are replaced once or twice in every decade, as in New York, for example. Speaking of New York, reminds us that in his reference to the sale of the municipal telephone exchange at Tunbridge Wells, Mr. Bennett says:—'The transaction has been denounced as the first Tammany operation in Great Britain.' What a funny idea of Tammany to foist on pretty, classic little Tunbridge Wells! The Tammany plan is to municipalise everything, so as to handle more public money and dispose of more offices and votes. 'Prof.' Frank Parsons, in discussing the same subject under the title, 'Reasons for Public Ownership of the Telephone,' sees the danger lurking in any allusion to Tammany, and argues that if a municipal plant is run corruptly, it is, therefore, not under municipal control; while, if it is well run, then it really is under municipal control. To quote his own words in regard to Philadelphia:—'Public ownership of the Government is essential to any real public ownership of anything else. We are told, for example, that the gas works of Philadelphia were allowed to get out of repair under public ownership. But the truth is, that Philadelphia did not have public ownership of the gas works any more than Russia has public ownership of her railways. The essence of ownership is control, and the Philadelphia gas works were controlled by the councils, and the councils were controlled by the corporations,' &c. In other words, any municipal plant that fails is not municipally owned; with the corollary that 'city councils' ready to make vicious deals with corporations, are angels of light when operating public utilities that will yield more to the councillor or aldermen if not sold out. We don't quite follow Mr. Parsons, but still we have long been expecting an ingenious scheme for disclaiming municipal failures. Here it is!"

Telegraph Cable Imports.—The value of the foreign telegraph cables and apparatus imported into this country during February last is returned at £9,506, as compared with £7,530 in January last.

Telegraph Wire Export Trade.—So far as the year has gone, it has been a very quiet one as regards the exports of telegraph wire and apparatus from this country. The shipments during the past month were the smallest for a long time past, amounting to only £19,676 as compared with £91,077 in January last, and £126,330 in February, 1902. During the two months ending with February, the exports have only reached a total of £110,753 as compared with £712,615 in the first two months of last year.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899	
Trinidad-Demerara No. 1	Aug. 27, 1900	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Guadeloupe-Martinique	May 7, 1902	
St. Lucia-St. Vincent	Nov. 18, 1902	
Martinique-Puerto Plata	July 10, 1902	
Guantanamo-Mole St. Nicholas	Aug. 4, 1902	
Cayenne-Pinheiros	Aug. 13, 1902	
Reissi-Issa-Reissi-Yemani	Oct. 22, 1902	
St. Jacques-Haiiphong	Jan. 8, 1903	
Jamaica-Colon	Dec. 31, 1902	
Paramaribo-Cayenne	Feb. 23, 1903	
Trinidad-Demerara No. 2	Feb. 27, 1903	
Zanzibar-Mombassa	March 7, 1903	
Myitta-Kanburi	March 16, 1903	
Landlines:—		
Route to Tientsin and Taku *via* Helampo	June 18, 1900	
Communication with Honduras-Central America	Feb. 26, 1903	

Telegraphists' Grievances.—The Postmaster-General was yesterday afternoon to receive a deputation of members of Parliament with regard to the desirability of a new inquiry being held into certain matters affecting employés in the postal telegraph service.

Wireless Telegraphy.—"Mr. Marconi's critics assert," says the *Daily Telegraph*, "that power stations such as he has established at Poldhu for long-distance communication will of necessity play havoc with wireless telegraphy of the less pretentious kind. At the Society of Arts on Monday night, Prof Fleming, F.R.S., armed with the results of his recent and uncontrolled experiments in Cornwall, challenged the contention before a large audience. He explained that not more than 100 yards from the great aerial at Poldhu was a single mast, equipped in the way usual in the case of Atlantic liners. At the Lizard, six miles off, were two receivers, the one tuned to the power station and the other to what he would call the ship station. His plan of operations was to have messages, which he had placed in sealed envelopes, and the character of which was known to no one but himself, transmitted simultaneously two at a time, one from the power station and the other from the ship station. There were 16 messages in all, some in cypher, and the result of the experiments, which extended over two hours, was to convince him that the power station and the ship station in no way interfered with each other. Prof. Fleming produced the original messages and 'tapes,' and went on to argue that, seeing that 25 Atlantic liners were now connected with shore stations, Mr. Marconi would hardly set to work to destroy their possibility of communication. Discussing various systems of syntonic telegraphy, and particularly noting the Anders-Bull selector, as ingeniously enabling messages to be read from a 'mess' of waves, if only the key was possessed, the lecturer dealt with the influence of the curvature of the earth. On that subject they had formerly to guess, but much had now been learned. Whether they would be able to get round to New Zealand he would not, however, venture to predict. The problem of whether there were such things as electrical fogs, requiring more power to get through them, was also one of the questions set before them, while the arrangement of power stations was a matter calling for real engineering ability and skill."

A meeting of Marconi's Wireless Telegraph Co. is called for 31st inst. to sanction an increase in the company's capital from £200,000 to £300,000. The called-up capital at present amounts to £157,083. At the end of the year to September last the debit balance stood at £37,947; but, in the circumstances, no one will think less of the company's prospects on that account. The proposal to increase the capital may be regarded as foreshadowing vigorous developments, and is, therefore, of interest to others than shareholders or intending subscribers.—*Financial News.*

In the House of Commons on Monday, Sir J. Leng asked a question with regard to the fitting of coastguard signal stations with wireless telegraphy apparatus, and in reply, Mr. Arnold-Forster said that the following stations had been established:—Dover, Culver Cliff, Portland, Rame Head, Scillys, and Roches Point. The following are proposed to be fitted during the next financial year:—Bere Island, Spurn Head, Alderney, St. Abb's Head, St. Ann's Head, Languard, Port Patrick, Duncansby Head. As regards commercial signalling, it is proposed to carry this out from the stations which will be included in the new Lloyd's-Admiralty agreement, which are:—Culver Cliff, Scillys, Spurn Head, St. Abb's Head, St. Ann's Head, Duncansby Head, and Roches Point.

The Northern of France Railway Co. have decided to put an installation of wireless telegraphy on the Dover and Calais cross-Channel steamers *Nord* and *Pas de Calais*. The land station is to be at the Harbour Station, Calais.

CONTRACTS OPEN AND CLOSED.

OPEN.

Batley.—April 18th. Eight electrical cars. See "Official Notices" to-day.

Belfast.—April 10th. Water-tube boiler with superheater and mechanical stoker, and superheater for Lancashire boiler. See "Official Notices" March 20th.

Belgium.—April 11th. Tenders for the Municipal Authorities of Liège, for the installation of a complete electric lighting plant at the Theatre Royal, Liège. Tenders to L'Annexe de l'Hotel de Ville, Liège, whence full particulars may be obtained for 30 francs.

Bridlington.—April 21st. Two 100-kw. steam dynamos, booster, crane, Lancashire boilers, battery, switchboard, mains, piping, street lamps, &c., for the electric lighting scheme See "Official Notices" to-day.

Bristol.—April 8th. Pumps, exciters, motors, pipework, coal conveyor and lamp standards. See "Official Notices" March 20th.

Burgess Hill.—March 27th. Complete electric light installation. See "Official Notices" March 20th.

Bury.—March 30th. The Electricity Committee invites tenders for the following plant:—Section C, boilers and ironwork; Section D, superheaters; Section E, economisers.

Darlington.—April 18th. Overhead equipment, switchboard extension, booster and battery, for the Corporation light railways. See "Official Notices" to-day.

Denmark.—March 31st. Copenhagen Public Lighting Department wants tenders for the supply of five water-tube boilers of 300 sq. metres heating surface capacity each. Particulars from the Copenhagen Belysningsvaesen, Vestre Boulevard, Copenhagen.

Eccles.—April 18th. Lancashire boiler, engine, alternator and other plant; also free wiring. See two "Official Notices" to-day.

Edinburgh.—April 6th and 13th. Carbons, also pavement and road-box frames and covers, &c. See "Official Notices" March 20th.

Finchley.—April 11th. Piping, switchboard, boosters, &c. See "Official Notices" March 20th.

France.—April 1st. Municipal Authorities of Paris; installation of a group of boosters at the Halles municipal central power station. Particulars from L'Hotel de Ville, Paris.

France.—April 7th. The French Post and Telegraph Authorities in Paris are inviting tenders until April 7th for the supply of 12 lots of magnetic apparatus, and 28 lots of telephone transmitters and receivers. Particulars may be obtained from, and tenders are to be sent to, Le Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

Fulham.—March 30th. Mains for electric lighting. See "Official Notices" March 13th.

Gillingham.—March 30th. 500 tons coal, oil, and electricity meters. See "Official Notices" March 13th.

Glasgow. — April 3rd. The May-Oatway Fire Appliances, Ltd., are inviting tenders for some installations of their fire alarms in Glasgow. See "Official Notices" to-day.

Glasgow.—April 7th. Three 6,500-volt three-phase induction motors (700 H.P. each) for the electricity department. See "Official Notices" to-day.

Huddersfield.—April 16th. Uniform clothing for inspectors, motormen and conductors for the Tramways Committee. See "Official Notices" to-day.

Ipswich.—April 20th. Piping, pumps, &c., for the electricity scheme. See "Official Notices" to-day.

Italy.—April 9th. Italian Navy; electrical cables and wire of a total value of 300,000 lire (about £12,000), to be delivered to the Royal Arsenals at Spezia, Naples, Venice and Taranto. Particulars at the office of the Minister of Marine; at the headquarters of the Controller of Artillery and Arms; and at the Directorate-General of Royal Arsenals at Spezia.

Leek.—April 3rd. Two gas engines, two 60-KW. dynamos, cooling tanks, pipes, &c.; stoneware casings, cable work, &c. See "Official Notices" March 13th.

Lowestoft.—April 8th. Dry-back boiler and superheater, pump and accessories; piping, &c.; condenser, pumps and cooling tower; 500-KW. steam dynamo, &c.; switchboard. See "Official Notices" March 13th.

Maidenhead.—April 21st. One 200-KW. steam dynamo, and one water-tube boiler. See "Official Notices" to-day.

Manchester. — Electric lighting and organ-blowing arrangements at All Saints' Church, C.-on-M. See "Official Notices" March 20th.

Manchester.—March 28th. Portable combined electric light engine and air pump for the Fire Brigade. Particulars, Chief Officer, Fire Brigade.

Manchester.—April 16th. Direct current motors for the Electricity Committee. See "Official Notices" to-day.

Rangoon.—July 1st. The Municipal Committee wants tenders for carrying out its electric lighting license, and particulars, forms, &c., can be obtained from the officiating secretary (W. Shircore), Rangoon municipality, at Rs. 75 per set.

Sheffield. — March 30th. Cranes, coal shoots, ash elevator, constructional steel work, &c., for the new electric power station at Neepsend. Mr. S. E. Fedden, general manager and engineer. Specifications, &c, £5 returnable.

Stretford.—March 27th. Switchboards, &c.; battery, booster, &c.; motor-generators; meters. See "Official Notices" March 13th.

Sunderland.—March 27th. Annual supply of I.R. covered cables and stoneware casings; one fuel economiser. See "Official Notices" February 27th. Two Lancashire boilers. See "Official Notices" March 6th.

Trafford Park.—April 10th. The Trafford Power and Light Supply (1902), Ltd., wants tenders for a traction switchboard and accessories. See "Official Notices" to-day.

Walthamstow.—April 4th. Free wiring. See "Official Notices" March 13th.

Wednesbury.—March 28th. Motor-generators, boosters, accumulators, switchboards, cables, &c., and street work, meters, indicators, fuses, &c. See "Official Notices" February 27th.

Wimbledon.—April 6th. 500-KW. steam alternator, water-tube boiler, economiser, feed pump and pipework, and one steel or brick chimney shaft. See "Official Notices" March 20th.

CLOSED.

Belfast.—The Board of Guardians has accepted the tender of the Private Wire Telephone Co., of Belfast (who competed for the work with the National Telephone Co.), to provide a private exchange system at the Union Workhouse of 18 stations. The same company has likewise secured a contract for a private exchange installation of 25 stations at the New Royal Victoria Hospital, Belfast.

Blackpool.—A contract has been placed with Messrs. Crompton & Co., Ltd., for a sub-station equipment, consisting of automatic reversible booster, motor booster and switchboard, for the Blackpool, St. Annes and Lytham tramways.

Burnley.—The T.C. has accepted the tender of Messrs. Siemens Bros. & Co., for the supply of electric cable at £2,680.

Croydon.—The Board of Guardians has accepted the tender of Messrs. Pryke & Palmer for the supply of electrical fittings and appliances to the Union Workhouse for the next year.

The Corporation has accepted the following tenders:—Bergmann Electrical Works, motor balancer, £208; Messrs. Drake and Gorham, battery board, £176; Messrs. Babcock & Wilcox, Ltd., boilers, superheaters and mechanical stokers, £4,174; Messrs. Easton & Co., separately fixed superheater, £582; Mr. Charles Jackson, condenser house; Messrs. Foster Bros., additions to electricity works, £1,622 15s.

France.—The French Post and Telegraph Authorities in Paris have just given out contracts as follows:—Messrs. Aboilard and Co., Paris, 200 kilometres of telephone cable (one pair conductors), and 12 kilometres ditto (112 pair conductors); La Société Alsacienne de Construction, of Belfort, 200 kilometres ditto (one pair conductors), and 40 kilometres ditto (28 pair conductors); La Société Française des Cables Telegraphiques, of Lyons, 80 kilometres ditto (7 pair conductors); La Société Industrielle des Téléphones, of Paris, 80 kilometres (7 pair conductors), 20 kilometres ditto (56 pair conductors), and 36 kilometres ditto (7 pair conductors; and M. Grammont, of Pont-de-Cheruy, 240 kilometres ditto (7 pair conductors).

Gillingham (Kent). — The tender of Mr. R. D. Batchelor has been accepted by the U.D.C. for deepening the well at the electricity works at £825.

Grantham.—The T.C. having received six tenders for a refuse destructor, has accepted that of Messrs. Manlove, Alliott and Co., for one guaranteed to deal with 14 tons of refuse a day.

Honley.—In connection with the U.D.C.'s electric lighting undertaking, Mr. A. B. Mountain (electrical engineer for the Huddersfield Corporation), who has been retained by the U.D.C. to superintend the scheme, at a special meeting presented a report upon the tenders received, &c., and the Council on Monday last resolved to accept the following amongst other tenders:—Overhead wiring, switchboard and connections, the Alliance Electrical Co.; meters, Venner & Co.; gas engines and dynamos, British Westinghouse Co.

Isle of Man.—Messrs. Henley's Telegraph Works Co. have secured the contract for the supply and laying of high and low tension cables, including over 17 miles of extra high tension three-phase cable, for the Isle of Man Light Railway.

London.—STEPNEY. The B.C. has accepted an offer by the New Century Arc Lamp Co., to erect 20 arc lamps in Burdett Road, for the sum of £176 15s. 6d., per set of five lamps.

Openshaw.—Messrs. Browett, Lindley & Co., Ltd., have booked an extension order for one of their new type engines of 1,000-H.P. for coupling direct to a dynamo, for the Openshaw Works of Messrs. Sir W. G. Armstrong, Whitworth & Co. This engine will be the sixth which they have installed at these works, the powers varying from 150 to 1,500 H.P.

FORTHCOMING EVENTS.

Friday, March 27th.—At 8 p.m. Institution of Civil Engineers. Students' Meeting. "The Advantages of Motor-Driven Printing Machines," by J. G. Y. D. Morgan.

Saturday, March 28th.—At 3 p.m. I.E.E. (Students' Section). Visit to the General Post Office Telephone Exchange.

Wednesday, April 1st.—At 8 p.m. Society of Arts. "Application of Polyphase Motors to the Electrical Driving of Workshops and Factories," by A. C. Eborall. Prof. John Perry, F.R.S., will preside.

Thursday, April 2nd.—At 8.30 p.m. Röntgen Society, 20, Hanover Square. J. H. Gardiner on "Some Effects produced by Radiations."

Friday, April 3rd.—At 9 p.m. Royal Institution. Lord Rayleigh on "Drops and Surface Tension."

At 7½p.m. Junior Institution of Engineers. Westminster Palace Hotel. "Evaporative Trials of one of the Water-tube Boilers for the Chilian Ironclad *Libertad*," by H. E. Yarrow; "Greasy Condensation Water as Boiler Feed," by W. Paterson.

Saturday, April 4th.—At 3 p.m. Royal Institution. Lord Rayleigh on "Light: Its Origin and Nature." (Lecture VI.)

NOTES ON THE EARTHING OF DYNAMO-ELECTRIC MACHINERY.

By ARTHUR BLOEMENDAL, E.E., Vienna.

The fatalities which took place in Fulham at the New Year caused a big discussion on the advisability of earthing electric conductors. It might be of interest to consider this question in general, not only for low-pressure, but also for high-pressure installations.

My personal opinion is that it is hardly advisable to use a pressure of more than 200 volts alternating current in the case of domestic installations, as the maximum pressure under the assumption of a sine curve will then amount to over 280; in fact, I never employ a higher lamp voltage than 150 volts for alternating-current installations. This subject is of considerable importance, especially on the Continent, where almost all modern central stations for public lighting work on the three-phase system.

It might be objected that by using 200 volts between the conductors, the expenditure of secondary copper would be minimised. This, however, is not the case—or, at any rate, the difference in weight of copper between 200 and 150 volts need scarcely be considered. It is simply a matter of correct disposal and practical distribution of the sub-stations, in order to reduce the weight of copper to a minimum.

In the majority of cases each consumer would have his own house transformer, and the question is thus disposed of at once. Another method by which the difficulty may also be overcome consists in admitting 260 volts between the outer conductors of a three-phase system, which would give 150 volts between the neutral point and an outer conductor. The neutral conductor, under these circumstances, should be earthed. Apart from the fact that in certain cases the introduction of a fourth conductor is unpractical, the earthing of a conductor in installations with aerial conductors and in localities where frequent and severe weather disturbances occur provides a constant source of trouble at the transformer, and the safety which may be secured as a result of earthing the secondary neutral points is more than counter-balanced by the conditions just described.

In the case of three-wire direct current installations it is, of course, necessary to earth the middle conductor for lamp pressures of 200—250 volts, which also may be done without entailing any risk.

According to all past experience, for the human body a contact with about 300 volts is dangerous in a greater or less degree, depending on the circumstances under which a contact has occurred, and also on the constitution of the individual concerned. It is impossible, therefore, to lay down a hard and fast rule that lighting installations with a maximum pressure of 250 volts are permissible, seeing that this depends more particularly upon local conditions, and, in the case of industrial concerns, also upon the kind of industry carried on. It has been found—and a similar case was, a few years ago, brought very forcibly under my notice—that relatively very low pressures may be dangerous.

A workman employed in a spirit refinery came in contact with a conductor of the electric light installation, and received a shock of 90 volts, which caused the death of the man. Although this must be considered an abnormal case, it should, nevertheless, be kept in mind when planning an electrical installation. Examination showed that the individual in question was a decided alcoholist, and, as is well known, the continued consumption of alcohol tends to lower the resisting powers of the human body. I hardly think this pressure would ever prove fatal to the normal person.

In the case of installations such as the above, it seems, therefore, imperative to fit them up in such a way as to *exclude the possibility* of accidental contact with any part of the electric system, whether it be the conductors or the fixtures, and in executing any installation, special attention should be given to this point. This rule seems also to be capable of application to the Fulham case.

Much has been written on the protective value of earthing for high-pressure systems, and I might here refer to a practice which I have adopted with the United Electric Co., Ltd. (Vereinigte Electricitäts Aktiengesellschaft), of Vienna.

In order to prevent any fatal interference with high-pressure machinery and apparatus, two methods may be recommended, either the employment of complete insulation from earth, or earthing the parts which do not carry current. The latter method is to be preferred, as by a conscientious and practical application it ensures absolute safety and excludes any danger from handling the apparatus.

The high-pressure machines are surrounded with sheet-metal flooring, which again is connected with earth. The earthing-cable is carried round the sheeting one or two inches from the outer edge, thus forming a complete framework for the machine; only then is the earthing cable connected with the earth plate.

When working with or near the machine under pressure, the workman treads on the metal flooring, which must have the same potential as the skeleton of the machine itself. Naturally, the metal flooring must be so large that a contact with the machine is only possible while standing on the metal. This is important, as there may be a potential difference between the flooring of the machine shop and the metal sheeting, a fact which I have proved by actual tests. This should also be considered when making switchboards for high-tension installations. The United Electric Company, Limited (Vereinigte Electricitäts Aktiengesellschaft), make their high-pressure switchboards so that only low pressures are present on the front of the marble, and the whole of the instruments, such as ampere, volt and watt-meters, are provided with reduction transformers, which are arranged in an iron frame, at least 1·5 m. to the back of the marble partition. On this iron frame are also arranged the switches and safety accessories, and the switches are operated through levers. The handles of the high-pressure switches are earthed, while the switchboard itself is usually placed on an iron platform also connected with the earth. It is thus out of the question that the switchboard attendant can ever receive a fatal shock through contact with the high-pressure switches.

In a country like Austria, in whose Alpine districts huge water-powers are available, the so-called overland central station is of general occurrence, and the current is usually conducted by means of overhead wires to the separate communities in order to serve for lighting and power purposes. At the place of consumption itself the high pressure current is transformed into one of lower pressure; usually at the places in question iron derricks are erected, the lower parts of which are formed into small transformer houses. Thus the high-pressure conductor is led within the iron structure on the masts down to the transformer by means of insulated wires. Now, it has frequently been shown that pressure differences exist between the transformer house and the surrounding ground which constitute a danger to persons that happen to touch the house in question.

This objectionable feature is overcome by placing, as in the case of the machines above described, round the transformer house an iron plate, which, first, is earthed; and, secondly, electrically connected with the house itself. As a result of this, no potential difference can exist between the surrounding ground and the metal framework of the transformer house, and, consequently, there is no danger to passers-by. The metal flooring round the transformer house is covered over with earth. These methods are certainly preferable to that of insulating, as the maintenance of an absolute insulation is almost impossible, and a test of the excellence of the insulation appears to be surrounded with great difficulties, whereas it is always easy to ensure a good earthing.

NOTES.

Power Stations and Our Coal Supplies. — The Royal Commission on Coal Supplies met again on Thursday last week at Westminster, and took further evidence. We learn from the *Times* report that Mr. W. J. Crossley, of Crossley Bros., Manchester, gave evidence as to the construction and use of gas engines and the fuel economy effected by such use, both as regards the quality and quantity of the coal consumed. He said the gas engine could work with half the coal used by the best modern steam engines. Mr. C. Dellwik described the Dellwik process for manufacturing water gas, the composition of water gas, and the economies which may be anticipated from its use. Dr. E. Hopkinson, of Messrs. Mather and Platt, Manchester, in discussing the use of steam and gas engines for driving dynamos, said there would be a great development of power stations for the supply of motive power to both large and small users, and a great increase in the motor load of existing electric lighting stations. These power stations (unless the energy were primarily required for heating purposes) would be electric, on account of the much greater convenience and less first cost to the user of electric motors as compared with small gas engines. The electric generators would be driven by gas engines worked with producer gas, not so much on account of inherently greater theoretic efficiency of the system, when working under full load test conditions, as on account of the much smaller effect of the fractional load factor and the financial saving owing to the use of lower priced coals and the economy realised from the recovery of the ammonia, and, finally, the actual saving of fuel by the use of gas plant would be about 56 per cent. as compared with steam plant.

Metric System.—The Decimal Association has issued papers showing the position of the movement up to date, and appealing for support. In a pamphlet setting forth the weighty reasons why the metric system should be made compulsory throughout the Empire, the growth of public opinion is clearly shown. We notice that the kilogram is called the "kilo;" this appears to us to be a great mistake, seeing that the word is a prefix common to several units of measurement, and it might just as well be applied to kilometres or other units, with inevitable confusion. Further, many will object to the introduction of the Americanisms "meter," "liter." However, there is no strong reason why we should follow the French in this matter, and by adopting this spelling—if the influence of the Association and other agencies could bring it about—we should be in line with both Germany and America. The extracts given from British Consular reports form striking evidence of the handicap under which we compete with other manufacturing nations. By the way, we think that while the Standardisation Committees are at work, they ought to draw up complete sets of standards in metric measurements, corresponding with those which they are preparing in English units. What a pity it is that the latter could not be dispensed with altogether!

Workhouse Installation.—After long years of consideration (for the gentlemen who preside over the destinies of the Fulham Workhouse appear to be unanimous in declaring that they never do anything in a hurry), the Guardians have completed an electrical installation of some 2,100 glow lamps and two arc lamps. It must have been painful for such obviously considerate gentlemen to refrain for such a lengthy period from adopting what they evidently consider as an essential to the health and happiness—nay, even to the prolongation of the lives of the inmates of this institution. Of course, we may be sure that "no ordinary or monetary consideration" can have contributed to their tardy decision. The plant consists of two generating sets, each comprising an Allen compound high-speed engine coupled to a Greenwood & Batley multipolar dynamo and booster in tandem, and running at 500 revolutions per minute. The dynamos have an output of 250 amperes at 210 volts, and the boosters 90 amperes at 90 volts. The switchboard was constructed by the Consolidated Telephone Co., and the wiring throughout the building was carried out by Messrs. Roger Dawson, Ltd. A battery of 110 Hart cells is provided for light load. Steam at 65 lbs. pressure is obtained from the existing range of boilers, and is exhausted through a Boby feed-water heater. The engine house is lined throughout with white glazed bricks, and presents a neat and cleanly appearance. It is anticipated that 70,000 units will be utilised for lighting per annum, and the working expenses are estimated at 2d. per unit, or, including interest and sinking fund, at under 4½d. per unit. The capital cost of the installation amounted to £6,300, and the annual cost is calculated at £1,200, compared with £1,100 for gas at the present time. The work has been carried out to the designs and under the superintendence of Mr. F. Hastings Medhurst, consulting engineer.

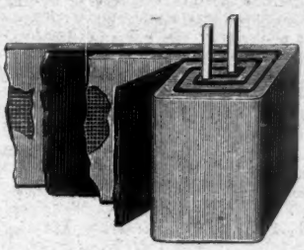
The Auer von Welsbach Osmium Lamp.—The much-talked-of Auer von Welsbach osmium lamp is, after many delays, at last being placed upon the market by the German Gasglühlicht Aktiengesellschaft, and the following details concerning its construction and efficiency are taken from a circular issued by that firm. The lamp is being made in the following sizes:—16-volt lamps, of 10 and 16-C.P.; 25-volt lamps, of 16 and 25-C.P.; 30-volt lamps, of 25-C.P.; and 32—44-volt lamps, of 25 to 32-C.P. It is thus necessary for four or more of these lamps to be worked in series when connected with a 100—120-volt circuit. The efficiency of all the different sizes of osmium lamp is stated to be the same—1·5 watts per candle, a marked improvement upon the 3½ to 4½ watts required by the ordinary glow lamp. With the latter type of lamp however, efficiency and life are in inverse ratio, and the lamp consuming 3½ watts per candle has under normal conditions a life of not more than 600 working hours. The life of the osmium lamp is given in the circular referred to as 500 working hours; this corresponds to that of the ordinary high-efficiency 100-volt glow lamp. The life limit in the case of the osmium lamp is reached suddenly by the burning through of the filament—an advantage, since continued working of a non-efficient lamp is thus rendered impossible. The cost of the osmium lamp in Berlin is 5·5 marks (5s. 9d.), of which total cost 75 pfg. (9½d.) can be repaid by the company when all the fragments of the osmium filaments are returned by the user of the lamp within 18 months of its purchase. The actual cost is thus 4·75 marks (4s. 11½d.) per lamp, which is five times that of the ordinary glow lamp, but as more experience is gained in the manufacture, and as a more plentiful supply of the osmium-holding earths becomes available, a considerable reduction in the cost price of the lamp is likely to occur. Comparing the costs for running lamps of equal candle-power, we have the following figures:—Glow lamp, 16-C.P., × 3·5 = 56 watts; osmium lamp, 16 C.P. × 1·5 = 24·0 watts. For a year of 1,000 working hours two lamps of each type would be required, and even at the present price of the osmium lamp, the saving in cost of energy would more than balance the increased first cost of the lamp.

	At 6d.	At 5d.	At 4d.	Renewals.
16-C.P. glow lamp—56 units per annum	28s.	23s.	18s. 8½d.	2s.
,, osmium lamp—24 ,, ,,	12s.	10s.	8s.	10s.
Saving of osmium lamp per annum ..	8s.	5s.	2s. 6½d.	

The advantage on the side of the osmium lamp, of course, increases with increased cost of electrical energy, and is greater in Berlin, where the average charge is 55 pfg. per KW.-hour (7d. per unit), than in Vienna, where the KW.-hour costs only 45 heller (5½d.). It is interesting to work out the cost of electricity, at which the advantage on the side of the osmium lamp, as regards the total annual running costs, disappears. This appears to be 3d. per unit for lamps of 16 candles and 1,000 working hours. The pure white light of the osmium lamp, its low heat radiation, and its slight susceptibility to variations in E.M.F., are advantages which, added to its high efficiency, go far to outweigh the disadvantages attaching to its higher first cost, the necessity for connecting a number of lamps in series, and finally the vertical position which is required in order to keep the filament in position when heated. As the osmium lamps are reduced in selling price, a wide field of use may be predicted for them.

The Ventilation of Engineering Shops, &c.—The Government report upon the ventilation of factories and workshops, to which we referred recently, contains a voluminous appendix of 17 tables relating to the size, number of occupants, and composition of the air in factories belonging to different trades; but it does not make any special mention of the electrical industry. Table K, however, in that appendix deals with the engineering and metal trades, and reproduces details of 20 tests, which show how little bearing upon purity of atmosphere a minimum air space per occupant really has. For instance, a badly ventilated first floor engineering shop in which the atmosphere was not contaminated from below was 12 ft. high, contained 50 men, and had an air space of 1,212 cb. ft. per head. It was fitted with gable windows and ridge ventilators, all closed, and the stairs were shut off. In daylight the least crowded portion of the room gave 13·3 parts of carbon dioxide per 10,000, and the most crowded portion 13·8 parts. When 55 gas jets were all alight, the carbon dioxide rose to 24·4 parts. In a long narrow first-floor electric fittings shop, which was fitted with one 42-in. Blackman fan at one end, 15 sash windows, 5 skylights (3 × 2 ft.), 20 air-bricks, and several Tobin tubes, the height was 10 ft., the number of occupants 300, the ground space 15·5 sq. ft., and the cubic space 155·4 cb. ft. per head; yet the air only contained 8·2 parts of carbon dioxide, although 19 gas jets were used. Here the air would have undoubtedly been very bad but for the unusually large amount of mechanical and natural ventilation. An interesting example of the "ventilation" of a room with previously fouled air is given in the case of a fourth-floor (top) L-shaped brass-finishing room, 8·5 ft. high, containing 24 men and 329 cb. ft. per head. This room had several windows closed, one skylight open, and two air grids in the floor from the room below. The room contained 15·5 parts of carbon dioxide at noon on a January day; but the air entering through the grids contained 12·8 volumes of carbon dioxide. Only two rooms mentioned in Table K were provided with electric light. These were cartridge-making rooms. One of these was 16 ft. high, contained 130 men, and 1,686 cb. ft. of space per head; it had large side windows and a doorway all open, and at 4.20 p.m. the air showed 3·2 parts of carbon dioxide—the same as outside. The other room contained ridge ventilators and skylights, mostly open, 226 men, an air space of 1,176 cb. ft. per head, and was found to give 5·0 parts of carbon dioxide at 4.20 p.m. on a January day. "The worst place of its kind visited during the inquiry" was a provincial tailoring shop, containing five occupants, and an air space of 314 cb. ft. per head, with no ventilation except a fire burning; this contained 53·2 parts of carbon dioxide at 7.30 p.m., when four large gas jets were alight; while in a cotton spinning works, third-floor room, "little end," with nine people and 10,169 cb. ft. of air per head, 32 gas jets and an arc light, 56·6 parts were found. In a cotton weaving shed, 12 ft. high, with 240 persons, and 1,620 cb. ft. per head, where the roof was almost air-tight, carrying an asphalted water tank, the carbon dioxide rose from 23·2 parts in daylight at 2.35 p.m. to 33·6 parts at 5.30 p.m. when 295 gas jets were in use.

The Tobiansky Accumulator.—The special feature of the accumulator invented by M. Tobiansky, of Brussels, is that it has plates of the Faure type wound in a spiral as in the Planté system. This arrangement gives a considerable capacity in a small bulk. The details of this curious accumulator are shown in the figure. The electrodes are formed of metal lattice work covered with active material; the ribbons thus formed are insulated from



one another by a fabric of spongy texture not affected by sulphuric acid. The system, according to the inventor, has the merit of possessing great capacity with little bulk. Thus elements weighing 4 to 5 kg. have a capacity of 120 to 150 ampere-hours, and at the same time dimensions of 10 × 15 × 16 cm. The efficiency, of course, is stated to be such as has never been attained by previous types. According to M. Tobiansky, this new accumulator would be the ideal type for the propulsion of ships, submarines and balloons, and of trains, tramcars, motor-cars, &c.

Yorkshire College Engineering Society. — At a meeting of the society on Monday, March 9th, 1903, Mr. R. J. J. Sloan, B.Sc., a former engineering student of the college, gave some experiences of a 12 months' stay in America, in which time he had visited and worked in a number of engineering shops. He had come to the conclusion that although America was ahead in some respects, it was overrated by some English newspapers, and by Americans themselves. The soft nature of American cast-iron favoured the use of labour-saving machinery, but nearly all their tool steel came from Sheffield. The hours of labour are longer than in England, and more work is obtained from the men. He considered, however, that the English mechanic, if trained in American methods, is quite capable of holding his own, and he had noticed that many positions of responsibility are held by Britishers. The boasted independence of American working men seemed conspicuous by its absence. National jealousy and distrust militates against trade unionism in the Eastern States, but it is fairly strong towards the West. The lecturer described a very accurate method of cost and store keeping employed in some shops, and compared in detail a number of American and English machines. He advised young engineers to pay a visit to the States. Prof. Goodman in the course of a discussion which followed, pointed out that England had made great progress during the last five years, and was keeping abreast of the times.

Personal.—We understand that Mr. Henry M. Hobart, after a temporary sojourn in Berlin, has now taken offices at Oswaldestre House, Norfolk Street, Strand, London, W.C., where he will practice as consulting engineer. Mr. Hobart is well known to electrical engineers both in the United States and in this country; for some years he was in charge of the dynamo designing of the B.T.H. Co., and it was under his supervision that the whole of the electrical plant on the Central London Railway was installed. Mr. Hobart was associated with Mr. H. F. Parshall in the writing of "Armature Windings" and "Electric Generators," which have taken their places as works of the highest authority and value in the design of dynamos, alternators and rotary converters; besides this, Mr. Hobart has frequently contributed important articles to the technical Press, including our own columns. We cordially welcome Mr. Hobart as a permanent resident among us, and we trust that a prosperous future lies before him.

On March 23rd the King held at Buckingham Palace an Investiture of the Imperial Service Order, and the following were among those whom his Majesty invested with the Insignia of the Order:—

Mr. Henry Davies, General Post Office.
Mr. Thomas Mason, General Post Office.
Mr. Walter Nops, General Post Office.
Mr. William S. Rushton, General Post Office.
Mr. David H. Somerville, General Post Office.
Mr. Edwin Winter, General Post Office, assistant solicitor.
Mr. Edwin Yeld, General Post Office.
Miss Constance Smith, General Post Office.

The *British Australasian* says that Mr. J. H. D. Brearley, B.Sc., R.E., M.I.E.E., has resigned his position as assistant electrical engineer to the New South Wales Government railways and tramways, with a view to joining the scientific staff of Messrs. Noyes Bros., of Sydney, Melbourne, Dunedin and Adelaide. He will shortly proceed to Dunedin as principal assistant engineer in connection with the construction of an electric tramway system in that city.

On Friday last at the Midland Hotel, Derby, Mr. W. E. Langdon, who recently resigned the position of superintendent of the electrical department of the Midland Railway Co., at Derby, was presented by his late colleagues and the staff of the department with a silver rose bowl and two silver fruit dishes (120 ozs.), also a silver tea and coffee service and salver (Georgian pattern) weighing 220 ozs. The proceedings were of a very [cordial] character, and some very high compliments were paid to Mr. Langdon and his work.

Prof. J. A. Ewing is announced for the appointment of the new Director of Naval Education.

On 19th inst. Mr. W. Massey, who has left the British Insulated and Helsby Cables, Ltd., to take up his new duties with the Willesden Council, was presented with a gold chain, seal and soversign purse, also oak smoker's cabinet, &c., by his colleagues and the employés on the Willesden Council and Metropolitan Supply Co.'s contracts of the B.I. & H.C., Ltd. The presentation took place at a smoking concert held at "William the Fourth" Hotel, Harrow Road, W.

The Association of Engineers-in-Charge. — The eighth annual dinner of the above Association was held on Saturday last at the Restaurant Frascati, and was in every way a great success. Upwards of 220 were present, of whom about half were visitors. The function was presided over by Mr. W. C. Clifford Smith, M.I.C.E., engineer to the L.C.C. Asylums Committee, and vice-president of the Association, and among others present were Messrs. J. Patten Barber, M.I.C.E., Pres. Soc. of Engineers; E. White, L.C.C., M.A.B., president of the Association; W. T. Hatch, A.M.I.C.E., M.I.M.E.; N. W. Hubbard; James Swinburne, Pres. Inst. E.E.; John Buley; and J. T. Belby.

The toast "The Association" was proposed by Mr. J. Patten Barber, who said that there were three classes of people that the world could well spare, viz., those who were too old to learn, those who were too lazy to learn, and those who considered they had nothing to learn. The Association of Engineers-in-Charge did not consist of men of this stamp, but of practical engineers ever ready to learn anything which would make for efficiency. To the true engineer his engine was almost a living thing; he certainly held conversation with it, particularly when things went wrong, and as showing the high place it held in his affections, he invariably referred to it as "she."

In replying, Mr. E. White (the president) contrasted the conditions of to-day with those obtaining 25 years ago. Then the engineer had very little to do, but now he was in almost every public department the all-important official. He struck a responsive note when he said that the remuneration of the engineer-in-charge had not increased proportionately with his responsibilities, but this was a state of things he was doing his best to remedy.

In a humorous speech Mr. Buley proposed the health of the chairman, who he prophesied would be promoted by his Committee to the position of Rear-Admiral of the Thames Fleet. The chairman retorted that, although his Committee had to deal with the insane, they themselves were very far from being so insane as this prophecy implied.

Mr. Buley, among other pithy remarks, gave a new rendering of the old saw, "Take care of the pence, and the pounds will take care of themselves." This, he said, had a broader meaning than was supposed; it did not mean literally pennies and pounds, but when applied to engineering it meant, "Take care of the details, and the results will take care of themselves."

In replying for 50 per cent. of the visitors to the toast proposed by Mr. Ardley, Chairman of the Association, Mr. Swinburne's jokes were directed against consulting engineers in general, and himself in particular. The County Council once discussed whether or not to engage a consulting engineer to design an electric lighting scheme, but someone objected that it would cost 3s. 9d. However, Mr. Swinburne was called in, and drew up the scheme; and having got it, the members of the Council said, "Now we know what to avoid," and carried out the work themselves, carefully avoiding everything Mr. Swinburne had proposed. [But we hope he got his 3s. 9d.—Eds. E.R.]

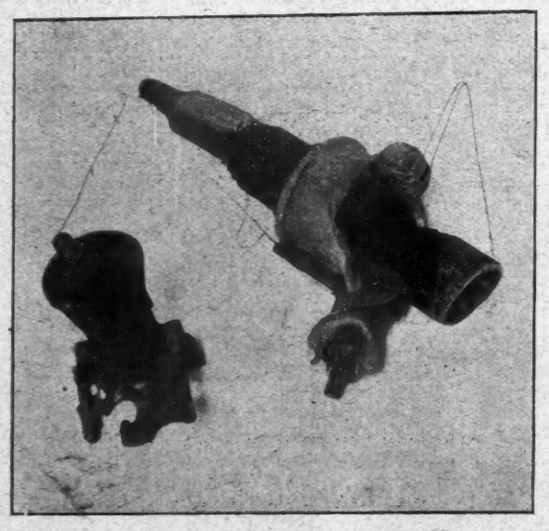
Mr. W. H. Booth replied for the rest of the visitors. A very pleasing musical programme was given during the evening.

Wood v. Greville.—With reference to the brief report of this case which appeared in our last issue, we find that the plaintiff is a contracting electrical engineer solely, not as there described. The defendant, we understand, is a solicitor and electrical engineer, occupying offices in premises owned by Messrs. Buchanan, in Holborn, which plaintiff had wired. The alleged libel was contained in a letter sent by defendant to the owner of the premises, wherein it was stated that a representative of the electric supply company condemned the work in his offices as unsafe, and had disconnected the circuit and informed him that he could not pass the wiring, which was so badly done as actually to be a source of considerable danger to the building, and that he was not surprised to find the whole installation condemned. We are informed that the reason of the Supply Company disconnecting defendant's lighting was due to the connections to the same, which had not been carried out by plaintiff, not being in accordance with the company's rules; and, furthermore, they had no occasion to condemn the work done by Mr. Wood. Plaintiff having given evidence, his Lordship remarked, without hearing any evidence on defendant's part, that this was a case for settlement, and ultimately counsel for the defendant unreservedly withdrew all the charges made against plaintiff, and agreed to pay taxed costs of the action. The Lord Chief Justice thought defendant ought to pay the costs of the action, and certified for a special jury.

The Italian Tour of the I.E.E.—There is every prospect of the tour in Northern Italy being a decided success. We learn that the party will number in all 140, of whom 25 or 30 are ladies.

Calcium Carbide Litigation Again.—On February 20th last an application was made to the Court of Appeal, consisting of the Master of the Rolls and Lords Justices Romer and Cozens-Hardy, by Mr. Colefax, in the matter of two appeals from a decision of Mr. Justice Buckley; these being the cases of the Acetylene Illuminating Co., Ltd., and another *versus* the Giffre Electro-Chemical and Power Co., Ltd., and others, and the same *versus* Thorn & Hoddle Acetylene Co., Ltd., and another. The former of the defendants mentioned were proceeded against for infringement of the Willson calcium carbide patents, and the latter for dealing in the alleged infringing carbide. Being, however, parallel actions with that brought by the Acetylene Illuminating Co. against the United Alkali Co., which was dismissed both by Mr. Justice Buckley and by the Court of Appeal, the application made to the Court of Appeal was for the dismissal, with costs, of these actions by consent. Counsel went on to state that "another action which raised exactly the same point, and in which an appeal was disposed of by the Court of Appeal last term, was going to the House of Lords." By this periphrasis we gather that the main action brought by the Acetylene Illuminating Co. against the United Alkali Co., which involves the validity of the Willson carbide patents in Great Britain, is going to be tried a third time. For various reasons we cannot help regretting that the owners of Willson's English patent are not content with two adverse decisions, but intend to tempt fate a third time. It is notorious that the calcium carbide market is always in a very unsettled condition; sometimes there is a plethora, and sometimes practically a famine in the material, and generally there is considerable difficulty in making the manufacture remunerative. It would certainly appear that there should be more advantage to be derived from spending money on experiments to improve the efficiency of the manufacturing process, on attempts to popularise the use of acetylene in country districts not provided with electricity or coal gas, and on a search after new employments for carbide, than on lawyers' fees. Moreover, the patent in question dates from the autumn of 1894; and in view of the enormous amount of arrears of work waiting for the leisurely attention of the House of Lords, the electrical manufacture of calcium carbide will almost become free to everybody by mere efflux of time before the patent has its legal value finally decided upon. It is interesting to note that in Germany, where there are no good carbide patents, but where the manufacturers have combined into a syndicate, the consumers appear to be fairly happy in a trustworthy supply of uniform material at a price which enables them to work their installations successfully; but in France, where the process is monopolised, or permitted only under license, the price and quality of the substance and the makers' commercial methods have brought the customers to a high state of irritation.

A Trolley Short.—The accompanying illustration shows the remarkable results of a bad short on the overhead gear at Halifax, with solid insulation. The molten iron from the bracket



Effect of Short on Overhead Work.

arm and hanger has partly filled the bottom of the gap in the arm. We are indebted for the original photograph to Mr. L. E. Harvey, superintendent of overhead construction, Halifax.

Calcium Carbide in Germany.—According to the official figures which have recently been published, the amount of calcium carbide imported into the German Empire during the nine months January—September, 1902, was 7,245·8 metric tons, in comparison with 5,906 tons for the corresponding period of 1901. The exports of carbide for the nine months of 1902, reached only 71·7 tons as against 177·7 tons in the first three quarters of 1901. The total importation for 1901 amounted to about 9,526 metric tons, so that on a similar computation that for 1902 should be some 11,690 tons. This figure very probably represents with some accuracy the quantity of calcium carbide actually consumed in Germany; because the bulk of the carbide factories controlled by German capital lie outside the boundaries of the country; and the amount of carbide manufactured in the works situated within the Empire may be set off against the quantity of geographically foreign material again exported.

Block Signalling by Telephone.—The system of signalling described in the Elec. Rev. of February 27, says a correspondent, is surely the least acceptable of all the systems which have been brought forward of late years in order to "reduce the possibility of collision between trains to a minimum." The description available is too meagre to admit of consideration of the technical aspects of the apparatus as a whole, but a telephone seems a most unpromising instrument to employ upon an engine (guards do not count in the least degree in respect of the control of a train), and there would appear to be reason for the distrust expressed by those who attended the trial on account of the "apparent delicacy of several of the principal organs" of the apparatus. In the normal operation of the telephone, the forces actuating the apparatus are very small, and it owes its use to its ability to respond to finely graded differences in the forces applied. What then is likely to be the condition of operation on an engine travelling at a high rate of speed, where vibratory forces, many thousand times greater than those referred to, are in constant operation? These forces act not only on the sense of hearing of those on the engine, but they will also act directly on the telephone equipment by reason of its design. Of course, it is said that the telephones are of a "modified" character, but if they are available for conversation the modification cannot be of a very radical character. It is possible, also, that there may be reason for the use of the word "communicate" in one part of the description, and the word "conversation" in another part. Communication does not necessarily mean conversation, and the communications, when running in a section, may be by a pre-arranged code. The mechanical arrangements for establishing connection between the travelling train and the section ends seem to be unique, but the difficulties in maintaining connection by such means would be almost insuperable for fast traffic.—The effect of the sag of the wire upon the trailing shoe or trolley when the latter is travelling at, say, 60 miles an hour, would be very great, and probably the only points at which connection would be made would be at the points of support of the wire. It would, moreover, be impossible to make a wire such as referred to, and supported as described, conform to the curves which are met with, and the effects due to the numerous and abrupt changes of direction experienced by the shoe at high speeds would be very great. Many interruptions in the continuity of the wire would also necessarily exist at crossings, points, &c., and the trolley or shoe would necessarily have to pick up these accurately at each place.

A good deal seems to be made of the arrangement for ringing alarm bells on the engines when the trains are on the same section at the same time. The ultimate object of the block system, however, is to prevent two trains ever getting on to the same section. In this case the alarm is not given until the rule has been broken, and the mere ringing of the bells will not indicate to the drivers the relative positions of the trains. Fast trains require several hundred yards in which to come to a comfortable stop, and if the first train is only a comparatively short distance in the section, the second may not have time to "pull up and start the conversation which shall decide the course to be pursued." The principle underlying the use of such apparatus as the sole means of conveying information respecting the condition of sections to the drivers of trains approaching or running over them seems a "throw-back" to first practice, and decidedly mischievous. No responsible officer could recommend the consideration of such a method for a moment. The various functions of the ordinary signals, the methods of operation, and the checks which experience has shown to be necessary, have been given too often in these columns to need recapitulation now. The running of traffic by verbal orders was long ago abandoned as unsafe—at least, in this country—owing to the difficulty of ensuring the carrying-out of the orders, assuming them to be fully understood. In this case verbal orders are given and received under conditions which are not conducive to accuracy of interpretation; there is no means of ensuring the orders being carried out, and there is no record or reminder of the conditions obtaining at any time.

The Henry A. Rowland Memorial Library.—A permanent memorial of the late Prof. Rowland is to be established, and it is to be one which shall at the same time promote the efficiency of the Physical Laboratory of the Johns Hopkins University. One of its former students has given a generous contribution with which to found a special collection of books, pamphlets and other publications in the field of radiation and spectroscopy. This is to be called the "Henry A. Rowland Memorial Library," and is to be placed in the Physical Laboratory of the University. Mr. Joseph S. Ames, director of the Physical Laboratory at Baltimore, is endeavouring to obtain the co-operation of observatories, laboratories and investigators so as to make the collection as complete as possible.

William Gilbert.—The Royal Geographical Society devoted its meeting on Monday to the commemoration of the great geographical and exploring enterprises of the reign of Queen Elizabeth, in connection with the tercentenary of her death. In the course of the proceedings Prof. Silvanus Thompson read a paper on "William Gilbert and Terrestrial Magnetism."

Royal Society.—Among the papers down to be read yesterday were the following:—

"The Electrical Conductivity imparted to a Vacuum by Hot Conductors," by O. W. Richardson. Communicated by Prof. J. J. Thomson, F.R.S.

"On a New Series of Lines in the Spectrum of Magnesium," by A. Fowler. Communicated by Prof. H. L. Callendar, F.R.S.

For Sale.—The Bexhill Corporation is offering 16 tons of old battery lead plates and glass boxes for sale. See our advertisement pages to-day.

The Carmont Centre-Steering Motor Vehicle.—Through the invitation of the Centre-Steering Traction Co., Ltd., of 47, Moorgate Street, E.C., we were on Wednesday enabled to witness a trial of one of the above vehicles at Hampton Court. The system consists in attaching an ordinary four-wheel tractor driven by steam, petrol or electricity to any existing omnibus or four-wheeled vehicle by removing the front wheels of the vehicle and substituting for them the rear wheels of the tractor (an operation which took about three minutes in the case of the omnibus used in the trial). The transformed (and now six-wheeled) vehicle is steered by the hind wheels of the tractor, which it is claimed gives most perfect results, correcting unsteadiness and the usual wobbling. Considering its somewhat ungainly appearance, which is apt to impress one at first sight—the vehicle certainly proved well able to turn round in its own length, and in other respects to be easily controlled. It has, moreover, the additional advantages that it enables the existing rolling stock to be utilised without further expense, a most important item for omnibus companies and large vehicle owners; further, all dead weight, oscillation, vibration, heat, smell, &c., are detached from the carrying vehicle, and the expensive luxury of rubber tires is dispensed with. The tractor on view was steam driven, weighing some 2½ tons charged, and capable of travelling an average distance of 30 miles at speeds up to 15 miles per hour. Steam is generated in a novel form of water-tube boiler (Carmont's patent) at 250 lbs. pressure; the furnace is situated within a feed-heating coil, and the disposition of the water tubes is such that the gases of combustion circulate up and down the outside of three rows of tubes on either side of the furnace; and in addition to utilising to the full extent the heat generated, the boiler is for all practical purposes smokeless. A vertical compound reversing "marine type" engine capable of developing 35 H.P., drives through chains on either side on to the front or driving wheels; the exhaust steam is condensed in a radiator or air-condenser fitted in the front of the tractor, the resultant water being led into the feed tank. A feed pump and injector for boiler feeding is provided. A wire-rope steering gear and two band brakes are provided on the tractor. It is stated that by this system a loaded omnibus or vehicle carrying 5 tons can be operated at a cost of 2d. per ton per mile. To successfully solve the question of efficiently and cheaply displacing the horse without affecting existing vehicles, has been the aim of these designers, and as things stand, they may claim to have scored well in their initial attempt.

Premium Systems.—At a meeting of the Institution of Mechanical Engineers, held at Storey's Gate on Friday evening, a paper was read by Mr. James Rowan on "A Premium System Applied to Engineering Workshops." He said that the premium system was started in his works in February, 1898, and since then the average times of the machinemen had been reduced during the four succeeding years by 20, 23, 31, and 37 per cent. The earnings of the men had increased by these percentages, and they stated they were thoroughly satisfied with the system. The system was founded on the principle that a regular hourly rate of wages was paid irrespective of output. A standard time was laid down for the performance of any given piece of work, and if the workman completed the task in a less time than the standard, he received pay in addition to the hourly wage in accordance with the time saved. At the worst, the man got his hourly wages, and if he could execute the job more quickly than the standard time, he earned additional money.

Removal of the I.E.E. Offices.—From Friday last until April 4th the Institution of Electrical Engineers' library will be closed. The library and offices of the Institution will in future be at 92, Victoria Street, S.W. It is in consequence of the removal that the library is closed until the date mentioned.

Business Announcements.—Mr. Taylor, of 14, Devonshire Square, E.C., has severed his connection with Messrs. McClure and Whitfield, of Stockport, having left London to take up an appointment in the Isle of Wight. Pending the appointment of another representative, all communications should be addressed to Stockport.

Mr. Charles Bell, having retired from the firm of the Ericsson Bell Telephone Co., of Glasgow, of which he was the sole partner, Mr. James McMillan has taken over the buiness, and will continue it under the same designation. Mr. McMillan has been associated with the company since its establishment.

Appointments Vacant.—A canvasser is required for the Manchester electricity supply department; a foreman for the Gravesend electricity works. See "Official Notices" to-day.

Obituary.—The *Times* records the death of one of the oldest of Australian bushmen and explorers, Mr. John Ross, who passed away in Adelaide at the age of 86. After acting as manager of remote sheep stations in the interior, Mr. Ross led the Government party that explored and determined the route of the transcontinental telegraph line that crosses Australia from Port Augusta in the south to Port Darwin in the north.

THE CENTRAL STATION ENGINEER.

There was some discussion at the last meeting of the Llandudno T.C., on the recommendation of the Electric Lighting Committee, that the salary of the electrical engineer, Mr. Morton, be increased by £50. After a good deal had been said for and against the proposal, the chairman ruled that as the Council in November, 1901, passed a resolution to the effect that Mr. Morton's application for an increase of salary be not entertained, it would be necessary to have that resolution rescinded before they could deal with the matter. In view of that ruling, the chairman of the Committee gave notice of a proposition to rescind the resolution at the next meeting.

The salary of Mr. E. G. Jennings, chief assistant clerk and bookkeeper to the St. Pancras electricity department, has been increased to £200 a year.

On Saturday evening last the staff of the Liverpool electric supply department met their old chief, Mr. A. Bromley-Holmes, at the Bear's Paw Restaurant, Liverpool, Alderman Petrie presiding. Mr. Alfred Clough (resident electrical engineer), on behalf of the staff of the electrical department, presented Mr. Bromley-Holmes with a testimonial, consisting of a silver rose bowl and an illuminated address. The chairman, Councillor R. Dart, Alderman F. Smith, Mr. W. H. Williams and Mr. R. Barrow spoke in appreciative terms of Mr. Bromley-Holmes' valuable work in Liverpool. Mr. Bromley-Holmes replied in feeling terms, thanking the members of his old staff for their kindness, and spoke highly of their loyalty towards him through their long association.

Mr. E. A Uttley has resigned his position as senior engineer-in-charge at the Dickinson Street and Bloom Street stations of the Manchester Corporation, having received the appointment of chief constructor and electrical inspector under the Rhodesian Government. Mr. Uttley leaves England on May 2nd.

Mr. A. R. Howden has been appointed shift engineer at the Dundee electricity works, Mr. A. A. Watkins having left to take up an appointment under the Edinburgh Corporation.

Mansfield T.C. has appointed Mr. E. Holcombe Hewlett as engineer of the E.L. undertaking at £250.

On Thursday evening last week a large gathering of the staff of the Hull Corporation Electricity Works took place at the Imperial Hotel, when Mr. Barnard, the City electrical engineer, who is leaving Hull at the end of the current month to take up his new post of electrical adviser to the Government of Ceylon, was presented with a handsome Ross-Goers Kodak camera, and a suitably inscribed gold bracelet for Mrs. Barnard. Mr. H. Bell, assistant electrical engineer, made the presentation on behalf of the staff. During the evening a varied and interesting musical programme was ably sustained by members of the staff and friends. The health of Mr. and Mrs. Barnard was toasted with musical honours.

NEW COMPANIES REGISTERED.

High-Speed Braiding Machine Co., Ltd. (76,604).—This company was registered on March 5th, with a capital of £60,000 in £1 shares (10,000 preference), to adopt an agreement with E. Crewdson and to carry on the business of manufacturers of braiding machines for the purposes (*inter alia*) of manufacturing coverings for insulating electric wire, of manufacturing corset and shoe laces, clothes lines, wickings, window and curtain cords, furniture braiding, fishing lines, rubber packing, trimmings, suspenders, watch guards and elastic cords, to sell, use and turn to account such machines, to acquire, own, develop and work any patents, inventions, licences and the like, &c. The first subscribers (each with one share) are:—H. W. Brown, 63, Mackenzie Road, Beckenham, clerk; J. A. H. Fuller, 50, Chatterton Road, Finsbury Park, N., clerk; F. H. Riches, Alverstoke, 44, Shenley Road, Camberwell, S.E., clerk; E. T. Church, 2, Kepler Road, Clapham, S.W., clerk; G. Troughton, 2, Bloompark Road, Fulham, S.W., clerk; A. D. Brown, 51, Reighton Road, Upper Clapton, N.E., shorthand writer; and W. W. P. Gaskell, 91, Nightingale Lane, S.W., solicitor. No initial public issue. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £500; remuneration, £50 each per annum, and £50 extra for the chairman.

Pearson Fire Alarm, Ltd. (76,641).—This company was registered on March 9th, with a capital of £250,000 in £1 shares, to acquire the business of the Pearson Fire Alarm System, Ltd. (incorporated in 1898), including among the assets thereof the benefit for all or any countries of three inventions known respectively as the Pearson Automatic Fire Indicator, the Pearson Automatic Telegraph Fire Alarm Apparatus, and the Pearson Automatic Railway Signal, or any one or more of such inventions, to adopt an agreement with the vendor company and its liquidator, and to carry on the business of mechanical engineers, ironfounders, manufacturers of fire indicators, extinguishers, escapes and engines, manufacturers of agricultural and other implements, tools and machinery, brassfounders, metal workers, glass manufacturers, electrical engineers, well sinkers, water supply engineers, &c. The first subscribers are:—W. Chamberlain, Brunesbenno Place, Ledbury, 200 shares; W. M. Furniss, 16, Hawes Road, Bromley, engineer, 1 share; K. L. Skinner, North Bank, St. Mary Cray, clerk, 1 share; G. B. Bowell, 6, Scarsdale Villas, Kensington, engineer, 1 share; Sir J. A. Cockburn, 10, Gatestone Road, Upper Norwood, director Central Insurance Co., 250 shares; H. E. Crawley, 9, Alexander Square, S.W., agent, 200 shares; and J. C. Kirk, 12, Nicholas Lane, E.C., assistant manager Central Insurance Co., 1 share. No initial public issue. The number of directors is not to be less than three nor more than seven; the first are W. Chamberlain, H. D. Lewis and Sir J. A. Cockburn, K.C.M.G.; qualification, £200; remuneration (excepting managing directors), £250 per annum (£150 extra for the chairman) and 10 per cent. of the net profits remaining after a divisible profit equal to 10 per cent. on the ordinary shares has been earned, whether distributed as dividend or not; such percentage to be divided between the directors and not to exceed £5,000 in any one year. Registered office, Jewin House, Redcross Street, E.C.

Yorkshire Private Telephone Co., Ltd. (76,692).—This company was registered on March 13th, with a capital of £6,000 in £1 shares, to adopt an agreement with the New System Private Telephone Co., Ltd., and to carry on the business of making, selling, buying, putting up, maintaining and working private telephones and telegraphs, whether electrical or otherwise, and of making, selling, leasing, working and maintaining electrical apparatus of all kinds. The first subscribers (each with one share) are:—A. Brearley, Oakdene, Batley, woollen manufacturer; J. Blackburn, Hanfield House, Healey, Batley, woollen manufacturer; W. Critchley, Batley Hall, Batley, colliery proprietor; J. S. Newsome, Commercial Street, Batley, printer and stationer; G. Hirst, White Lee Grange, Batley, manufacturer; G. E. H. Maggs, Batley, solicitor; L. W. Taylor, Batley, solicitor; and W. D. Burlinson, Branch Avenue, Batley, incorporated accountant. No initial public issue. The number of directors is not to be less than four nor more than eight; the first are A. Brearley, W. Critchley, J. S. Newsome and E. H. Lamb (nominated by the New System Private Telephone Co., Ltd., which company has the right to nominate one other director); qualification of ordinary directors, £10; remuneration as fixed by the company. Registered office, Branch Avenue, Batley, Yorks.

East India Construction Syndicate, Ltd. (76,647).—This company was registered on March 10th, with a capital of £300,000 in £100 shares, to promote and finance companies, for the construction of tramways, tramroads, light railways and electrical power and lighting works, generally to further the construction, equipment and development of such works, &c. The first subscribers are:—R. H. Prestwich, 13, Marsden Square, Manchester, cotton spinner, 100 shares; A. L. Ormrod, 10, Half Moon Street, Manchester, stockbroker, 100 shares; J. B. Lloyd, 22, Little Peter Street, Manchester, merchant, 10 shares; R. S. Boddington, Strangeways, Manchester, brewer, 50 shares; F. A. Roberts, The Common, Windermere, gentlemen, 50 shares; M. S. Bles, Charlton Street, Manchester, merchant, 50 shares; and J. D. Williams, 46, Princess Street, Manchester, merchant, 10 shares. No initial public issue. The number of directors is not to be less than three, nor more than seven; the first are E. Davis, F. Roberts and P. Tarbuit; qualification, £5,000; remuneration as fixed by the company. Registered office: 19, St. Swithin's Lane, E.C.

Lord & Shand, Ltd. (76,737).—This company was registered on March 18th, with a capital of £3,000 in 2,500 preference shares of £1 each, and 10 deferred shares of £10 each, to acquire the business of an electrical and mechanical engineer carried on by A. F. Lord, at Plymouth, as "Lord and Shand," and to carry on the same and the business of manufacturers of electrical, magnetic, telephonic, telegraphic and other appliances, &c. The first subscribers (each with one preference share) are:—R. Bromhead, 19, Princess Square, Plymouth, chartered accountant; A. F. Lord, 5, Brookdown Villas, Saltash, electrical engineer; C. D. Bromhead, 12, Princess Square, Plymouth, accountant; B. Bagnall, 4, South View Terrace, Hartley, Plymouth, chartered accountant; M. F. Staplyton, Redworth, Totnes, late Lieut. R.A.; J. E. Holmes, Plympton, land agent; and G. F. B. Shand, 2, The Crescent, Surbiton, gentleman. No initial public issue. The number of directors is not to be less than two nor more than five; the first are A. F. Lord, J. E. Holmes, M. F. Staplyton, R. Bromhead, and G. F. B. Shand; qualification, £100; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Bullers, Ltd. (62,020).—The annual return of this company was filed on December 27th, 1902, when 15,000 ordinary and 15,000 preference shares had been taken up out of a nominal capital of £400,000 in 20,000 ordinary and 20,000 preference shares of £10 each. £10 per share has been called up on 7 ordinary and 15,000 preference, and £150,070 has been paid. £149,930 is considered as paid on 14,993 preference shares. Mortgages and charges: nil.

Typewriting Telegraph Corporation, Ltd. (66,332).—The annual return of this company was filed on February 10th, when 70,800 shares had been taken up out of a nominal capital of £100,000 in 100,000 shares of £1 each. 17s. 6d. has been called up on 25,700 shares, and £23,362 10s. has been received. 44,100 shares are considered as fully paid. 300 have been forfeited, nothing having been paid thereon. Mortgages and charges: nil.

British Westinghouse Electric and Manufacturing Co., Ltd. (62,919).—The annual return of this company was filed on February 11th, when 200,000 preference and 75,000 ordinary shares had been taken up out of a nominal capital of £2,750,000 in 400,000 preference shares of £5 each, and 75,000 ordinary shares of £10. £5 per share has been called up on the preference shares, and £1,000,000 has been paid. £750,000 is considered as paid on 75,000 ordinary shares. Mortgages and charges: £500,000.

T. C. Welding & Co., Ltd. (Electric Fittings, &c., Liverpool) (70,309).—Issue on February 5th of £400 second debentures, part of series created October 2nd, 1902, to secure £500, charged on the company's undertaking and property, present and future, including uncalled capital and unpaid calls. No trustees. Total amount previously issued of same series, £100.

Potteries Electric Traction Co., Ltd. (57,968).—A memorandum of satisfaction in full of a charge dated June 16th, 1902, to secure £45,000, has been filed.

Northampton Electric Light and Power Co., Ltd. (28,640).—Issue on February 19th of £250 debentures, part of series created June 3rd, 1896, to secure not more than two-thirds of the paid up capital, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Total amount previously issued of same series: £96,400.

Woking Electric Supply Co., Ltd. (46,175).—Issue on February 7th of £100 debentures, part of series created November 2nd, 1899, to secure £25,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Total amount previously issued of same series: £19,050.

South American Electric Co., Ltd. (59,646).—A floating charge on the company's undertaking and property, present and future, including uncalled capital, dated February 9th, 1903, to secure not more than £500, has been registered. Holder: F. Hyland, 81, Cannon Street, E.C.

Thomas Parker, Ltd. (Electrical Engineers, Wolverhampton) (40,975).—Issue on February 23rd of £600 debentures, part of series created June 23rd, 1898, to secure £75,000, charged on the company's undertaking and property, present and future. No trustees. Total amount previously issued of same series: £59,400.

Barcelona Tramways Co., Ltd. (6,544).—Issue on February 16th of £51,900 debentures, part of a series created by resolutions of December 5th, 1897, and December 15th, 1902, to secure £200,000. Property charged: The company's undertaking and property, present and future, subject to £48,700 5 per cent. debentures. Trustees: W. F. Hamilton, K.C., 25, Old Square, W.C.; H. Brown, Danehurst, Burbage Road, Herne Hill, S.E.; and N. Kennedy, 37, Walbrook, E.C. Total amount previously issued of same series, £148,100.

Adams-Randall Telephone Patents Co., Ltd. (61,457).—The annual return of this company was filed on January 23rd, when 50,000 ordinary and 8,890 preference shares had been taken up out of a nominal capital of £60,000 in 50,000 ordinary and 10,000 preference shares of £1 each. £1 per share has been called up on 7 ordinary and 8,890 preference. £3,744 has been paid, leaving £153 in arrears. 49,993 ordinary shares are considered fully paid. Mortgages and charges, £9,450.

Electric Canal Haulage Co., Ltd. (60,462).—This company's annual return was filed on February 24th, when seven shares had been taken up and paid for in full out of a nominal capital of £3,000 divided into 3,000 shares of £1 each. No mortgages or charges.

Eastern Telegraph Co., Ltd. (6,338).—This company's annual return was filed on February 19th, when £5,987,635 stock had been taken up and paid for in full, and £12,255 had been registered but not issued, out of a nominal capital of £6,000,000, divided into £4,000,000 ordinary and £2,000,000 preference stock. Mortgages and charges, £1,898,845.

Mutual Telephone Co., Ltd. (56,621).—This company's annual return was filed on January 12th, 1903, when 6,283 preference and 10,348 ordinary shares had been taken up out of a nominal capital of £250,000, divided into 20,000 preference and 80,000 ordinary shares of £5 each. 6d. per share has been called up, and £1,184 7s. 6d. has been received, including cash paid in advance of calls. No mortgages or charges.

Electric Danite Co., Ltd. (76,275).—Issue on February 6th of £500 debentures, part of a series created same date to secure £1,000, charged on the company's present and future capital stock, goods, patents, chattels, effects, real property, patents, plant, goodwill and other assets. No trustees. No previous issue of same series.

Cardwell, Boorman, Ford-Lloyd, Ltd., Electrical Engineers, London (68,268).—£900 debentures, created and dated February 25th, 1903, charged on the company's undertaking and property, present and future, including uncalled capital, have been registered. No trustees.

Electric Carriage and Storage Co., Ltd. (73,476).—A debenture for £5,000, dated February 17th, 1903, charged on seven motor-cars, all considerations payable to the company on sale of its assets or part thereof, or on promotion of any new company, and the company's undertaking and other property, present and future. Holder, G. Pauling, 26, Victoria Street, S.W.

Newcastle-upon-Tyne Electric Supply Co., Ltd. (27,997).—Issue on March 5th of £2,700 debentures, part of a series created October 3rd, 1901, to secure £250,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Total amount previously issued of same series: £140,800.

British Miller Signal Syndicate, Ltd. (75,537).—Issue on March 4th of £800 second debentures, part of a series created December 15th, 1902, to secure £1,200, charged on the company's undertaking and property, present and future, including uncalled capital, subject to 24 first mortgage debentures of £125 each. No trustees. No previous issue of same series.

Bastian Meter Co., Ltd. (53,304).—Issue on March 5th of a debenture for £50, part of a series created by resolutions of April 22nd, May 23rd and June 10th, 1901, to secure £6,000, charged on land and premises in Kentish Town, and all the company's property, present and future, including uncalled capital. Trustees: H. A. Saunders, Chesterfield; and D. J. Cowles, Manor House, Felixstowe. Total amount previously issued of same series: £4,650.

Direct United States Cable Co., Ltd. (11,597).—This company's annual return was filed on February 16th, when 60,710 shares had been taken up out of a nominal capital of £1,360,000, divided into 65,000 shares of £20 each. All the shares are considered as fully paid. Mortgages and charges, *nil*.

Fleetwood and District Electric Light and Power Syndicate, Ltd.—This company's annual return was filed on January 27th, when 19,657 ordinary and 1,995 deferred shares had been taken up out of a nominal capital of £22,000, divided into 20,005 ordinary and 1,995 deferred shares of £1 each. £1 has been called up on 12,959 ordinary and 403 deferred shares, resulting in the receipt of £13,349; £13 remains in arrears; 6,698 ordinary and 1,592 deferred shares are considered as fully paid. Debenture stock, £6,960. Resolution authorising creation of further £5,000 debentures confirmed January 15th, 1903.

Bright's Light and Power, Ltd. (58,290).—A first debenture for £6,000 and a second debenture for £2,000, both dated March 5th, 1903, charged on the company's undertaking, concessions and freehold, leasehold and all other property, including uncalled capital, have been registered. Holders, the River Plate Trust, Loan and Agency Co., Ltd., 52, Moorgate Street, E.C. Memoranda of satisfaction in full of a debenture dated August 11th, 1902, securing £6,000; second debenture dated November 19th, 1902, securing £1,000; and a third debenture, dated November 24th, 1902, securing £1,000, have been filed.

D. Santoni & Co., Ltd. (Manufacturers of electrical appliances, London) (74,406).—£300 debentures, created and dated March 5th, 1903, charged on the company's undertaking and property, present and future, including uncalled capital, have been registered. No trustees.

Jerrard's Automatic Track Cleaners, Ltd. (76,512).—Issue on March 9th of a debenture for £250, part of a series created same date to secure £500, charged on the company's undertaking and property, including uncalled capital. Holders:—George Cohen, Sons & Co., 600, Commercial Road, E. No trustees.

Traction Company of the United Kingdom, Ltd. (63,634).—Issue on March 2nd of a debenture for £1,400, part of a series created December 23rd, 1902, to secure £3,000, charged on a debt of £5,000 due from the Traction Development Co., Ltd., and the company's undertaking and property, present and future, including uncalled capital. No trustees. Total amount previously issued of same series: £1,600.

British Electric Traction Co., Ltd. (49,855).—Issue on February 26th of £250,000 debentures, part of a series created June 16th, 1899, to secure not more than half the subscribed capital. Property charged: The company's undertaking and property, present and future, including uncalled capital. Trustees: Electric and General Investment Co., Ltd., 1–2, Great Winchester Street, E.C. Total amount previously issued of same series, £1,150,000.

Sherard Cowper-Coles & Co., Ltd. (Engineers, London) (67,136).—Issue on March 12th of £2,600 debentures, part of a series created by resolutions of December 3rd, 1901, and February 7th, 1902, to secure £6,500 charged as a floating security on the company's property, present and future, except uncalled capital. No trustees. Total amount previously issued of same series, £2,750.

Electric Timber Seasoning and Preservation Co., Ltd. (61,428).—A debenture dated March 9th, 1903, to secure £1,022, charged on the company's undertaking and property, present and future, has been registered. Holder: H. B. Weaver, 11, Stone Buildings, Lincoln's Inn, W.C.

Adams-Randall Telephone Patents Co., Ltd. (61,457).—Issue on March 4th of £250 debentures, part of a series created April 22nd, 1899, to secure £10,000, constituting a first charge on the property, patents, rights and leasehold premises. Holders: London and Foreign Contract Corporation, Ltd., 5, New Broad Street, E.C. Trustees: F. Davies, 26–7, Finsbury Pavement, E.C. Total amount previously issued of same series, £9,450.

ELECTRICITY SUPPLY ACCOUNTS.

Manchester Municipal Electric Supply.

The returns of the Manchester electrical department for the year ending March, 1902, are given briefly, in view of the early issue of the 1903 accounts.

The area of supply includes Manchester, Withington, Moss Side, Levenshulme, Heaton Norris and Denton.

At this time the department were engaged in large works extensions, the increase in capital expenditure during the year being £301,014. Three generating stations are to be completed, the total capacity of plant installed at the date of this return being 14,450 KW. With the completion of the tramways a heavy traction load is expected, this year being the first in which such a load was obtained.

The progress of the undertaking during the past four years will be gauged from the following figures:—

Year.	Units generated.	Units sold.	Revenue account.		Average revenue per unit sold.	Total cost per unit sold.
			Income.	Expenditure.		
1899	5,633,534	4,773,247	£71,941	£31,006	3·50d.	1·54d.
1900	6,927,396	6,355,872	86,297	49,905	3·24d.	1·84d.
1901	9,639,973	7,794,098	101,631	59,288	3·12d.	1·82d.
1902	12,697,590	10,502,299	134,462	74,054	3·07d.	1·69d.

The total number of consumers is 4,030, an increase of 260 on the previous year. Of the 10,502,299 units sold, 8,512,189 were taken by private consumers, 38,120 for public lamps and 1,951,990 for tramways. The prices charged for lighting were 5½d. per unit, or 1½d. per unit and £1 15s. per quarter per unit of demand; for motors, charges as above, or if run 48 hours per week at 1½d. per unit inclusive.

GENERAL STATEMENT.

Year ending March 31st	1901.	1902.	Inc.
Total capital expenditure ...	£863,293	£1,164,307	£301,014
Number of units sold ...	7,794,098	10,502,299	2,708,201
Maximum load in KW. ...	6,876	9,140	2,264
Equivalent 8C.P. lamps connected	319,736	348,709	28,973
Number of public arcs	29	29	
Number of motors	672	774	102
Revenue Account:—			
Gross revenue	£102,237	£135,063	£32,826
Gross expenditure	£59,208	£73,950	£14,742
Gross profit	£43,029	£61,113	£18,084
Average price per unit sold ...	3·12d.	3·07d.	—·05d.

Year ending March 31st, 1902.—Revenue Statement.

	Per unit.	Gross.	
Sale of energy per meter—			
Manchester	—	£119,725	
Withington	—	2,563	
Moss Side	—	1,330	
Tramways Department ...	—	10,167	
Manchester public lighting ...	—	318	
	3·07d.	£134,103	
Meter rents	·006d.	290	
Sundry	·00d.	70	
Interest on reserve fund	·013d.	601	
	3·08d.	—	£135,063
Working Expenses.			
	Per unit.	Gross.	
Coal	·42d.	£18,093	
Oil, waste, water and engine room stores	·16d.	4,605	
Salaries and wages incurred in generation and distribution, &c.	·18d.	7,766	
Repairs and maintenance of buildings, engines, boilers, dynamos and public lamps ...	·37d.	19,985	
Works and distribution costs	1·13d.	£50,449	
Rent, rates and taxes	·19d.	£7,782	
Management expenses, salaries of engineer, secretary, clerical staff	·21d.	9,179	
General establishment charges, stationery, printing, law charges and insurance	·12d.	5,120	
Special charges	·04d.	1,420	
Total costs	1·69d.	—	£73,950
Profit Statement.			
Interest		£28,014	
Sinking fund		20,244	
To public works loan commissioners		4,715	
To reserve fund account		341	
Provision for bad debts		104	
Balance carried down		7,635	
Gross profit ... ... —			£61,113

Of the gross profit of £61,113 (including £601 interest) a sum of £53,374 was absorbed by financial charges, compared with £39,433 in the previous year, £104 was provided for bad debts, and a balance of £7,634 carried forward.

Glasgow Corporation Electricity Department.

These accounts are of considerable interest as indicating the progress of one of the largest municipal electrical supplies during 12 months ending May, 1902. Compared with the previous year, the financial results are very satisfactory, as, with an increased output of about 30 per cent., the working expenses are only some £3,700 in excess of the previous year, and a large profit has resulted.

The Department runs four generating stations—Port Dundas (12,100 H.P.), Pollokshaws Road (4,400 H.P.), Kelvinside (1,080 H.P.), and Waterloo Street (2,320 H.P.), a total of 19,900 H.P., as against 16,380 in the previous year, though, owing to the change of pressure of supply, the plant at Waterloo Street is being gradually discarded.

By an arrangement with the Tramways Department, and to cover the excessive winter loads, additional energy is taken from their Coplaw Hill sub-station and delivered into the Pollokshaws Road station of the Lighting Department.

GENERAL STATEMENT.

For the year ending May 31st—	1901.	1902.	Inc.
Total capital expenditure ...	£836,146	£962,727	£126,581
Number of units sold	6,813,991	9,282,043	2,468,052
Maximum load in KW.	6,308	7,950	1,642
Equivalent number of 8-C.P. lamps	368,342	491,306	122,964
Number of public arc lamps ...	348	500	152
Number of motors in use ...	427	682	255
Revenue Account—			
Gross revenue	£79,449	£103,940	£24,491
Gross expenditure	£50,756	£54,525	£3,769
Gross profit	£28,693	£49,415	£20,722
Average price per unit sold ...	2·84d.	2·78d.	—·06d.

During the year the number of consumers has increased by 33 per cent. to 5,374. Of the total, 11,122,606 units generated, 9,282,043 were sold as follows:—Private consumers, 8,384,696; public lamps, 884,839; by contract, 12,508; and of the remainder, 829,713 were used on the works, and 1,010,850, or 9 per cent. were lost in distribution.

The prices charged are various:—Domestic consumers, theatres, &c., flat rate 3½d. per unit (250 volts), and 4d. per unit (200 and 100 volts); churches, flat rate 3d. per unit; shops, warehouses, offices, &c., on demand indicator system, 6d. per unit for 365 hours per annum, 1d. (250 volts), 1½d. (200 volts) and 2d. per unit (100 volts) after. Motors, 1½d. per unit (250 and 500 volts), and 2d. per unit (200 volts); public street lighting, 10-amp. arcs £14 and 7½-amp. arcs £12 per annum; stair lighting from 25s. to 37s. 6d. per lamp per annum.

REVENUE STATEMENT.

	1901.		1902.		
	Gross.	Per unit.	Gross.	Per unit.	Inc.
Sale of energy—					
Private consumers ...	£74,524	—	£97,050	—	—
Public lamps	4,925	—	6,890	—	—
	£79,449	2·84d.	£103,940	2·78d.	—·06d.

The works costs during the year show a substantial reduction of ½d. per unit generated, principally contributed by coal, which, despite the increased output, figures at some £6,000, or ·40d. less than the previous year. Special charges—being the proportion of cost of lamps and fittings supplied to consumers consequent on changing the supply voltage—has been charged to revenue this year as last, the item being decreased from ·19d. to ·09d. per unit, and the total costs now stand at 1·40d.

Cost of Production.

For the year ending May 31st—	1901. Gross.	Per unit.	1902. Gross.	Per unit.	Inc.
Coal..	£19,667	·75d.	£13,551	·35d.	—·40d.
Oil, waste, water, and engine room stores.	1,559	·06d.	1,918	·05d.	—·01d.
Salaries and wages incurred in generation and distribution, and attending public lamps.	7,454	·28d.	9,187	·23d.	—·05d.
Repairs and maintenance of plant, cables and public lamps.	7,881	·30d.	14,141	·37d.	·07d.
Works and distribution cost ..	£36,561	1·39d.	£38,797	1·00d.	—·39d.
Rent, rates and taxes ..	5,080	·19d.	5,979	·15d.	—·04d.
Management expenses, salaries of engineer, secretary, clerical staff.	2,444	·09d.	3,430	·09d.	·00d.
General establishment printing, stationery, advertising, &c.	1,718	·06d.	2,780	·07d.	·01d.
Special charges incurred in replacing fittings owing to change in voltage, also carting.	4,949	·19d.	3,539	·09d.	—·10d.
Total costs ...	£50,752	1·92d.	£54,525	1·40d.	—·52d.

Of the gross profit of £49,415, financial charges absorb £37,984, a moderate increase on the previous year, and the balance, £11,431, has been applied to reducing the capital accounts for buildings and plant at the Waterloo Street and Kelvinside stations, which are discarded owing to the change of voltage from 100 to 250.

Profit Statement.

	1901.	1902.
Interest on loans	£24,546	£29,416
Sinking fund	8,662	8,568
Deficit (transferred from reserve fund) ...	—4,517	—
Depreciation on works and machinery ...	—	11,431
Gross profit	£28,692	£49,415

CITY NOTES.

The Marconi Co.'s Report.

In considering wireless telegraphy, it is essential to regard it from two points of view—the scientific and the commercial. It is safe to say that no new industry has been developed without losses, and no great gains obtained without grave risks being incurred. The history of submarine telegraphy is a record of hope deferred, of repeated examples of what cautious people would call throwing good money after bad. The eventual reward to the pioneers was the reward of sterling merit, and the faith in scientific possibilities was followed by commercial success. In recalling these facts, it is well to bear in mind that the pioneers were mainly exercising their own judgment and risking their own money. In later years the field of investment has widened, and the field of individual judgment has narrowed. Hence greater care is needed in the consideration of the financial side of enterprises which appeal to the wonderment of people in general. A case in point is the Marconi Wireless Telegraph Co., Ltd., whose report was published on the 25th inst., and contained the notification that it was proposed to increase the capital by £100,000, owing to the great expansion of business. The fact that "the receipts for the year are £5,489 in excess of the general charges," would seem to suggest that the company has already assumed a regular dividend-earning position, but it is important to inquire whether the receipts for the year have been of a normal or abnormal nature. "Sales and royalties" of £17,415 are apparently of a normal nature. "Stock, £9,299," needs further explanation, since the same figure appears amongst the assets in the balance-sheet. Transfer fees, £694, indicates numerous transactions in shares, but can hardly be helpful from a trading standpoint. £1,000 as "consideration for an option" not exercised, cannot be regarded as a probably recurring receipt, and the "payment of £16,443 by the Canadian Government" can hardly be expected to be an annual event. The expenditure during the year amounts to £39,364, and includes an amount of £1,075 3s. 5d. for "life insurance," which might seem to call for further mention in the report. The patents are valued at £80,663. A very good showing is made in the list of steamships fitted with Marconi apparatus, and considering the utility of wireless telegraphy for communication under circumstances in which a cable is impossible, there may be some reason for regret that £41,000 of the assets are represented by "trans-Atlantic stations."

W. T. Glover & Co., Ltd.

The directors' report, which was presented at the fifth ordinary annual general meeting, held at Trafford Park, Manchester, on Monday, 23rd inst., reads as follows:—

"The directors submit herewith the audited accounts of the company for the year ended December 31st, 1902, from which it will be seen that the amount standing at the credit of profit and loss account is £4,280 10s. 6d. This is arrived at as follows:—

Manufacturing profit			£34,981 17 11
Add—Dividends on investments, profit on sales of shares, underwriting commission, and miscellaneous receipts			4,380 16 6
			39,312 14 5
Deduct—Management and administration expenses, &c.	£25,742	16 5	
Interest, bankers' charges, &c.	3,299	9 8	
			29,042 6 1
Leaving			10,300 8 4
Add—Balance from last account	3,430	2 2	
Less—Voted for directors' remuneration ..	200	0 0	
			3,250 2 2
			13,530 10 6
Deduct—Interim dividend on preference shares to June 30th, 1902	2,500	0 0	
Interest on first mortgage debentures for year ended December 31st, 1902	4,250	0 0	
Amount transferred to debenture redemption fund	2,500	0 0	
			9,250 0 0
			£4,280 10 6

"On referring to the balance-sheet it will be observed that the directors have created on the assets side a suspense account amounting to £35,149 9s. 11d. This is made up as follows:—

Amount written off the value of the old works and machinery at Salford		£15,138 15 10
Amount written off sundry investments		22,823 15 0
Amount written off patents		787 5 6
Amount to provide for contingencies and certain experimental outlay		8,499 13 7
		47,249 9 11
Less—Amount transferred from reserve fund		12,100 0 0
		£35,149 9 11

"Mr. Cooper was appointed a director of the company in August, and Mr. Ormrod in December, 1902, as representing large interests in the company, and since their appointment have been investigating and examining into the various assets of the company, with the result that it has been decided to write off the amounts stated above.

"The total special amount which it has been decided to write off from the property and investments, &c., amounts to £35,149 9s. 11d.; and the directors have pleasure in informing the shareholders that Messrs. Edmunds, Samuelson & Fawcus, the original vendors, have generously offered to meet the position by placing at the disposal of the company ordinary shares to the nominal amount of £35,150, and have placed transfers to this amount in the hands of Messrs. Ormrod and Cooper in trust for this purpose. It is proposed to apply to the Court to reduce the ordinary capital of the company by this amount.

"The meeting referred to in the accompanying notice is called for the purpose of authorising this reduction of capital, which reduction will subsequently require to be sanctioned by the Court.

"Messrs. Edmunds, Samuelson and Fawcus, towards the end of the year, have, by arrangement with the board, cancelled their agreements under which they acted as managing directors at a salary, and since that date have not accepted any remuneration for their services.

"The balance-sheet now presented sets forth the true position of the company, as far as can be ascertained, and in addition to writing down the special items above referred to, the depreciation on capital outlay has been dealt with upon a more liberal scale than in previous years, and provision made for certain contingencies.

"Further, the stock-in-trade has been priced upon a more conservative basis than in previous years, and in the opinion of Mr. Claremont, the acting managing director, is not stated at more than cost, leaving a profit on the realisation.

"While the turnover has increased by 10·22 per cent., there is little doubt that the electrical trade generally has been for some months, and is now, suffering from very severe depression, which accounts for the exceedingly low prices at which orders have been placed. The many electrical projects on foot, it is hoped, will rapidly produce a favourable reaction. In the meantime every effort is being made to reduce expenses and to economise in various directions.

"The business at the Salford Works has been discontinued, and such property as has not been realised has been let.

"The capacity of the works is far greater than the demand at present upon it, and the necessity of ample orders is apparent in order to meet the expense of the large staff which is permanently necessary.

"Improvements in manufacture have been effected, and especially in the production of a non-lead-covered paper cable, for which there is likely to be a substantial demand.

"The directors regret that it is not possible to pay a dividend on the preference shares for the half-year ended December 31st last, but if the suggested reduction of capital is carried into effect, the company will be placed in the position to resume payment of dividends if earned.

"The directors recommend that Mr. E. A. Claremont be appointed managing director of the company, and that an agreement be entered into with him to carry this into effect."

"The whole of the directors retire, but are eligible, and offer themselves for re-election. The auditors, Messrs. Edwin Guthrie and Co., also retire, and being eligible, offer themselves for re-election.

"(Signed) A. L. Ormrod, *Chairman.*

"Colin Cooper, "E. A. Claremont, "Henry Edmunds, "W. P. J. Fawcus, "A. H. Howard, "Godfrey B. Samuelson } *Directors.*

"F. J. Warren, *Secretary.*

"Trafford Park, Manchester,
March 14th, 1903."

The meeting was held on Monday at Trafford Park, but we have no information as to what transpired.

Potteries Electric Traction Co.

Mr. Garcke presided at this company's meeting on 18th inst. at Hamilton House, and in moving the adoption of the report, he said it was extremely satisfactory. They were able to place an increased amount to the reserve fund, and to recommend the payment of an increased dividend—5 per cent. for the past year as compared with 4 per cent. for the preceding year—and they were also able to carry a larger amount forward. That good result had been obtained notwithstanding bad weather. Bad trade and an epidemic also acted against the traffic, but the result of the year's working was sufficiently good to indicate the progressive character of the undertaking. Last year they had to report upon the disturbance of the traffic in the Fenton district owing to the condition of the permanent way. He was sorry to say that their negotiations continued the best part of the past year, and it was only quite lately that they had been able to come to terms with the local authority so as to enable them to enter upon the work of re-construction. Despite those difficulties, they had carried 14½ millions of passengers in the Potteries district, which showed an increase of about one million over the preceding year. That improved result was very largely due to the efforts that had been exercised by the management to reduce the expenses, and it was satisfactory to note that the proportion of expenses to receipts was for the past year 59 per cent., as compared with 62 per cent. in the preceding year, and it was gratifying to know that that reduction in expenditure had been effected, notwithstanding that there had been an increase in the wages paid to the employés. The general expenses showed a small increase, but that was mainly due to increased rates which all industrial undertakings had to pay, and also to an increased payment for insurance. He was glad to say that the traffic receipts were still improving, and for the first two months of this year they showed an increase of something like 10 per cent. upon the corresponding period of 1901. The total capital expenditure was now £671,698, and their subscribed capital in shares and debentures was £656,512, so they would see that they expended rather more than their available capital, and they had certain other capital expenditure in view. Firstly, they must go on with the Fenton reconstruction, that now they had arranged with the local authority, and it was also very desirable that some of the routes which had recently been sanctioned under the Light Railways Act should be proceeded with forthwith, because the opening of the extensions would immediately improve the results to be obtained by the company. Therefore, additional capital was necessary, and the directors proposed raising about £25,000 in ordinary shares, and £25,000 in preference shares, which would give them power later on to issue another £25,000 of debentures if they thought it necessary. The Light Railway Order sanctioning the extensions, to which he had referred, was passed last year, and would add 5 miles to the system. It afforded him some pleasure to be able to report the successful working of the parcels conveyance system, which was started rather more than a year ago. At the present time they were carrying on an average about 12,000 parcels a month, which compared with about 4,500 this time last year, so they would see that it was progressing. So far the department had not yielded them much, if any, profit, but the directors entertained no doubt whatever as to its profitable character in the future. The first year was not a very easy one for developing it, because the Board of Trade objected to their running trailer cars. However, they went as a deputation to the Board of Trade, with the result that the department had permitted them to use the trailers. He must refer to a matter personal to himself. They would notice that he was one of the retiring directors, and he thought that the time had come when he should retire from the chairmanship of the company, although for the present he would continue to act as a director. As managing director of the British Electric Traction Co. it was his duty to join those boards. He was often twitted with joining far too many, but he did not belong to a single company which was outside that organisation, and he made it a rule that as soon as the company was developed to such an extent that he felt he could retire without breaking faith with the shareholders, he did so in order to devote himself to the still increasing work of the British Electric Traction Co. He should propose to the board that the deputy-chairman, Mr. Cornwallis-West, should be elected to succeed him in the chair. He would just like to mention what they had done for the Potteries district. When they took over the North Staffordshire Tramways they had about six miles of tramways and carried 3 millions of passengers per annum. The undertaking had been developed to such an extent that there was now scarcely a village in the district which was not served by their system of electric trams, and they were now carrying 14½ million passengers as compared with the three millions when they came upon the field, and the traffic receipts which at that time were £21,500 had increased to over £92,000.

Mr. Cornwallis-West seconded the motion, and the report was adopted.

South London Electric Supply Corporation.

Mr. Geo. Ellis (chairman) presided on 18th inst. at the offices, Bengeworth Road, Loughborough Junction, S.E., over the ordinary general meeting of the above company, and in moving the adoption of the report, said it gave him great pleasure to present the report and accounts for the past year, from which they would have observed that a substantial increase of business had been secured, and this, coupled with considerable reduction in costs in the generation and distribution of the current, had brought the company to a dividend-earning stage. It was true that the dividend proposed was not a large one, but each succeeding year could not but show an improvement in that respect, and they had every reason to believe that the improvement for the present year would be substantial. When it was remembered that the station had only been in operation for three years, this result must be regarded as satisfactory, and it compared favourably with the majority of other metropolitan companies, which in their earlier years of working were unable to distribute dividends. During 1902 they increased the number of lamps connected by over 16,000, or, in other words, by 28 per cent., and as the lamps connected for the previous year were only about 13,000, it was gratifying to find that the supply they gave continued to produce an increased demand, and, in fact, the results for the first two months of this year showed a still further increase, the lamps connected from January 1st to date being 5,282 against 3,320 for the same period last year. Towards the end of last year they decided to adopt an alternative method of charging for lighting by a sliding scale, in order that the long-hour burning class of consumer, who was the most remunerative to them, might be encouraged, and they were pleased to say that these rates have already had a very satisfactory effect. In order to assist in developing the company's business, they had also adopted schemes whereby consumers could rent from the corporation complete installations, motors, and arc lamps, as experience had shown that the initial cost of such in many cases hindered the adoption of electricity for either lighting or motive power. Although these schemes were only introduced late last autumn, he was glad to report that there were already connected more than 100 arc lamps, and several motors and complete installations through the system. There was very little to add to his remarks at their last meeting there regarding the litigation between the local authority and themselves as to the dust destructor. The suggestion for a settlement thrown out by Mr Justice Wright at the hearing of the case, led to a meeting between representatives of both bodies, but nothing yet had been settled. The station being erected by the London County Council on their premises was being rapidly completed, and they fully anticipated that for about seven months of the present year they would be supplying power in accordance with the terms of their contract. He noticed, as a matter of fact, that the Prince of Wales would open the tramways on May 15th, so that their contract would commence from that date. He would like to draw attention to the fact that had they not in the first instance erected plant much in excess of their then requirements, it would have been impossible to have entered into that agreement; at the same time they were in a position, without incurring any heavy capital expenditure on their station, to develop their lighting and power business in the meantime. Referring to the various items of expenditure as set out in the revenue account, they would, he felt sure, agree that very considerable reductions had taken place in these. It was especially noticeable in the reduced cost of coal, from £6,432 in 1901 to £4,744 in 1902, although close on 200,000 more units were sold to consumers. That reduction was in a very great measure due to the condensing plant which it was decided to instal in 1900, but which was not in satisfactory service until early in 1902, owing to the great delay in its completion. As regards the bank overdraft, they had been able to make satisfactory terms with the bank, so as to give them ample time to consider the desirability later on of making a debenture issue. This need, he thought, be only a small one, sufficient to clear off all capital expenditure to date, and provide means for the extension of the company's mains and outside plant to keep pace with anticipated increase of business. The consumers connected were becoming numerous and spread fairly equally over the whole area, which was nearly six miles in length, with an average width of over one mile. The mains were not yet laid in several thoroughfares, but they would, of course, develop there gradually. The engineer had reported that the whole of the distributing networks of the company's system were in excellent order, and it was very satisfactory to note that the supply had been maintained throughout the past year without cessation. No doubt by that time they were all in touch with the figures of the accounts, and would have observed that there was an available balance of £7,026 7s. 3d., out of which the board recommend the payment of their first dividend of £1 15s. per cent. for the year.

Mr. J. Atherton, in seconding the motion, congratulated the shareholders on the past year's working, which had resulted in the payment of a first dividend to the shareholders. He looked on the future of the company with a great deal of confidence. He was the largest shareholder, and if they only had patience, he hoped, instead of 35s. per cent., they would have a reasonable dividend next year. They had turned the corner, and he had no fear himself about the future. In addition to getting the tramway load for the

L.C.C., it gave them additional help for building up their own business. The agreement was bound to run for 18 months, and it might run for years. They had erected a station with a capacity for supplying 200,000 lamps, and the tramway demand had come in at the right time.

The report was adopted, and the retiring directors re-elected.

County of London and Brush Provincial Electric Lighting Co.

Mr. J. B. Braithwaite, jun., presided at this company's meeting, held on Monday at Winchester House. He said that they had at last obtained the sanction of the Board of Trade for the amalgamation of the different accounts, thus showing their entire operations at one glance. There had been no change in the amount of capital issued, but they had received during the year about £60,000 on the last issue of preference shares. The loans from bankers had increased considerably, and now stood at £190,000. They had, owing to purchase negotiations in the Camberwell district, felt themselves compelled to obtain the capital they required from their bankers rather than by any further issue of capital. They had also received a certain amount of capital during the year from the sale of their interest in the Dover Co., but, so far as the balance-sheet was concerned, the only change was the increase of the bankers' loan. Last year he reminded the shareholders of the steady progress the company was making towards paying its way out of the profits made from its London stations. He then said that in 1899 they had had to provide the whole of the dividend on the ordinary shares out of the profit on the sale of the Richmond undertaking, and he pointed out that in 1900 a considerable portion of that dividend was drawn from the same source. Last year he was able to congratulate them on the fact that the whole of the dividend had been earned from the London stations, though they had still to draw for repairs and renewals from other sources. He also expressed the hope that the year 1902 would see them with sufficient increase in their profits to enable them not only to pay the dividend, but also to provide for repairs and renewals without having recourse to other sources. He was glad to say that that expectation had been really more than realised, for they were able this year not only to pay their dividend and the interest on the large loan, but also to place about £10,000 to the depreciation and other funds out of revenue. Their progress had thus been well maintained. The actual revenue of the past year had amounted to £109,652, which showed an increase over the previous year of something like £16,000. After certain allowances had been made, the actual increase in their revenue from the London stations was £12,170, an increase of 14·6 per cent.; the increase in working expenses had only been about £1,000, or 3 per cent., making the increase of net profit 22 per cent. That could hardly be considered unsatisfactory, especially bearing in mind the fact that the winter months of November and December had been of no assistance to them in the matter of fogs. After referring briefly to the purchase of the Dover undertaking and the improved dividend—8 per cent. instead of 7 per cent.—on the Bournemouth system, the Chairman went on to refer to the year's very satisfactory decrease in working expenses. Broadly speaking, they had reduced the cost of generation by ¼d. per unit, and there was some possibility of this being still further decreased, though they were getting down to a figure where there was not much margin for reduction. The output had been half a million units in excess of the previous year, and they had been generated at a cost of just over £1,000. The increase in lights had also been satisfactory, the applications being for rather over 90,000 lights. The company again stood at the top of the tree in that respect, with the single exception of the Charing Cross Co.'s City undertaking, which had connected 90,883 lamps during the year; but this was due to the latter company taking over a lot of the City Co.'s customers whose premises were already wired. The motors on circuit had increased very satisfactorily. They had connected the equivalent of 1,639 H.P. to the mains during the year, an increase of about 33 per cent. on the previous year; they now had about 4,424 H.P. connected, and the applications for increased horse-power were coming in very satisfactorily. The average price received was £4 16s. 9d. per horse-power, which compared extremely favourably with the price of gas engines or any other form of motive power. The increase on the whole of the lights was 28 per cent., and the price obtained was slightly better than in 1901—viz., 4·6d., or $\frac{1}{10}$d. better on the average. The average price received for motive power was 2·46d. After dwelling in some detail upon the long series of injustices which companies were being subjected to at the hands of municipalities, and especially the troubles of their company in Bermondsey, Southwark, Camberwell and Stepney, the Chairman referred to the L.C.C. Bill then before Parliament, and thought that municipal insults were beginning to abate.

Mr. Joseph Shaw seconded the adoption of the report, and after a few questions had been asked and answered, it was carried.

The resolution declaring dividends and re-electing directors and auditors having been passed, the meeting proceeded to consider resolutions increasing the capital of the company to £1,600,000 by the creation of 40,000 additional ordinary shares of £10 each and 40,000 additional preference shares of £10 each; and increasing the amount which the directors were authorised to borrow from £400,000 to £800,000.

The Chairman, in moving the resolution, explained that in regard to the increase of share capital, there was no intention of making any such fresh issue at present, but in view of future extension of business, and the fact that they were proposing to increase their borrowing powers, the board had thought it a convenient time to bring forward that proposal also; when an issue was made it would, no doubt, be in the form of second debenture stock at 4½ per cent., and it was proposed to issue it at 103.

The resolution was adopted, and a vote of thanks closed the meeting.

Tynemouth and District Electric Traction Co.

The directors report that the capital expenditure during 1902 amounted to £7,811, the total capital outlay on the construction, re-construction and electrical equipment of the lines being £86,215. The subscribed share and debenture capital is now £73,800. The total revenue was £15,327, and the expenditure £9,912 14s. 2d. There is £1,500 placed to depreciation and reserve; 5 per cent. is paid on the preference shares, and 7½ per cent. on the ordinary shares, £138 being carried forward. Notwithstanding the bad weather the receipts increased by £4,160. The doubling of the track along the Grand Parade, Tynemouth, has been completed, and has greatly facilitated the working of the services. Messrs. C. S. Drummond, Emile Garcke, and E. A. Paris have resigned their seats on the board, and Mr. H. S. Day has been elected a director.

	Period from March 18th to Dec. 31st, 1901.	Year ended Dec. 31st, 1902.
Miles open—		
Route miles	3·71	3·71
Single line	1·16	1·16
Double line	2·55	2·55
Number of passengers carried	1,723,218	2,417,575
Average receipts per passenger	1·51d.	1·50d.
Average expenditure per passenger ..	·78d.	·96d.
Proportion of expenses to receipts ..	·51 p. c.	64 p. c.
Number of cars in stock	22	22

The meeting was held yesterday at Donington House.

North Staffordshire Tramways Co.

The directors' report for 1902 says that in accordance with the agreements entered into with the Potteries Electric Traction Co., Ltd., £6,700 first debentures and £9,900 second debentures have been issued to that company in part repayment of the balance of expenditure on the electrical equipment of the tramways. The company has now issued the total amount of the authorised debenture capital, viz., £100,000 first mortgage debenture bonds and £40,000 second mortgage debenture bonds. The expenditure during the year on the electrical equipment, permanent way, &c., was £291, and there is an amount due to the Potteries Electric Traction Co. of £12,761. The balance to the credit of the profit and loss account for the year after including the amount payable by the Potteries Electric Traction Co., Ltd., under the working agreement and charging debenture interest, is £4,797 8s. 10d., which, added to £176 10s. 1d. brought forward from last account, makes an available balance of £4,973 18s. 11d. The directors propose 6 per cent. on the preference shares, 5 per cent. on the ordinary shares, and £174 to carry forward. Mr. Emile Garcke is the director who retires by rotation, but he does not offer himself for re-election. Mr. Bond has been appointed to succeed him, subject to confirmation.

Evered & Co., Ltd.

The directors show that after providing for debenture interest, amounting to £2,346, and income-tax £1,492, a net profit of £19,229 10s. 8d. remained for 1902, making, with £4,559 6s. 4d. brought forward, £24,188 to be dealt with. The directors propose a 10 per cent. dividend for the year, which will absorb £17,074, £1,000 is written off buildings, £1,000 is transferred to equalisation of dividend account, and £5,114 is carried forward. The directors consider the results very satisfactory, bearing in view the excessive competition which occurred during the whole of last year, and is still maintained. During the past year considerable sums have been spent in introducing electric power at the Surrey Works. Alterations in this respect have been carried out under the advice of experts, and it is anticipated that the results will enable the company to produce their goods in a more profitable manner and effect considerable economies in working.

Direct Spanish Telegraph Co.

The Marquess of Tweeddale presided at Electra House on Tuesday over the meeting of this company, and he said that the report compared favourably with that for 1901. Without drawing in any way upon either the contingent or reserve funds—as they were obliged to do last time to pay the dividend—they were able, after paying £5,000 to reserve, to pay the usual 10 per cent. on the preference, and 4 per cent. on the ordinary shares, and to carry £780 to the contingency fund. That result was due to an increase of £3,151, in the traffic receipts, and to a substantial reduction in the cost of cable repairs. In 1901 the Marseilles—Barcelona cable was interrupted 115 days, but in 1902 for only a few days. The chairman proceeded to go through the items in the accounts which showed increases and decreases, and paid a tribute to the excellent work done for the company by Mr. Gerhardi, who had just retired from the post of secretary and manager on a pension of £500 a year. In the new secretary, Mr. Preddle, they had an old officer of the company of great experience and approved ability.

Sir J. D. Pender seconded the adoption of the report, and it was carried, the retiring director and auditors being afterwards re-elected.

Cork Electric Tramways and Lighting Co.

The report for 1902 states that receipts have amounted to £48,360 and the expenses to £28,465, leaving £19,895. 5 per cent. is paid on the preference, and 5½ per cent. on the ordinary shares, £3,000 being placed to depreciation and insurance. During the year additional debentures have been issued to the extent of £25,000, and the company has repaid the £20,484 loans appearing in last year's balance-sheet. The capital expenditure during the year has been considerably less than in any previous year of the company's existence, amounting only to £2,418, which has been spent on small cable extensions and in connection with additional lighting consumers.

The meeting of this company was held on Thursday last week at 83, Cannon Street, Mr. A. R. Monks presiding. The chairman, in proposing the adoption of the report, said there were very few remarks necessary to commend the report to the shareholders. He thought they would agree that it showed that the company was in a prosperous and progressive state. They were a little better off this year than last, principally owing to the reduction in the cost of coal which had now resumed its normal price. They were also helped to some extent by the Exhibition which was held in Cork last year. Owing to those circumstances, the profits had been sufficient to allow them to write off large sums for depreciation, &c., and also to pay an increased dividend. They had added very little to the capital account last year, and he did not think that account would be materially increased this year. They would have to provide for more plant for the autumn lighting, but that would not cost more than from £7,000 to £8,000.

Mr. W. H. B. Martindale seconded the motion, and the report was adopted.

South Staffordshire Tramways (Lessee) Co.

The directors' report for 1902 says that the total revenue for that period amounts to £40,827 18s. 10d., and the expenditure, including £3,802 18s. 4d. rental of lines, to £37,591 14s. 4d., leaving a net profit of £3,236 4s. 6d., which, added to the amount of £1,625 7s. brought forward from the previous account and £691 3s. 4d. transferred from suspense account, makes an available balance of £5,552 14s. 10d., which the directors propose should be applied as follows:—Depreciation and reserve fund, £1,500; 7 per cent. dividend, £3,500; balance carried forward, £552 14s. 10d.; equal £5,552 14s. 40d.

The subscribed capital in ordinary shares amounts to £50,000. The total capital expenditure now amounts to £59,629 4s. 7d., in addition to £7,490 11s. 10d. expended on the reconstruction of tramways of the South Staffordshire Tramways Co., repayable in cash or debentures under the terms of the lease. A Bill is being promoted in the present session of Parliament to confirm agreements already made with local authorities for leases to this company and to authorise the other local authorities having jurisdiction over the tramways worked by the company to grant leases of the tramways within their area to the company after they have purchased same, and to sanction running powers and for other purposes. The decrease in receipts during the present year is owing partly to the unfavourable weather, but mainly to the reconstruction for electrical running of the lines in West Bromwich, during which time only a disjointed service could be maintained. The directors, however, are confident that upon the completion of such reconstruction the receipts and profits will not only recover but considerably exceed their former totals. The line from Darlaston to Moxley has also been reconstructed for electric traction, and the lines in Tipton from Great Bridge to Burnt Tree are now under reconstruction for the same purpose. An issue of 10,000 6 per cent. cumulative preference shares of £5 each is being made to enable the company to meet the cost of the reconstruction of the lines from Darlaston to Moxley, and those in Tipton from Great Bridge to Burnt Tree, also of new cars and for other purposes.

		1902.	1901.
Miles open:—			
Route miles	Electric	7·89	7·89
	Steam	10·18	15·18
Single line		12·75	12·75
Double line		5·32	10·32
Number of passengers carried		7,353,624	6,861,683
Average receipts per passenger		1·28d.	1·42d.
Average expenditure per passenger (apart from line rent)		1·11d.	1·07d.
Proportion of expenses to receipts		86 p.c.	75 p.c.
Number of cars in stock	Electric	33	20
	Steam	28	28

The meeting of the company was held last Friday at Donington House.

Northern Counties Electricity Supply Co.

Mr. J. D. Milburn presided at this company's meeting, which was held at Newcastle on 19th inst., and in moving the adoption of the report, of which we published an abstract last week, he said that the capital expenditure, £88,000 odd, included the expenditure on the Blyth, Spennymoor and Alnwick power stations, which begin the new financial year with an earning capacity in lamps already connected which the directors are satisfied will, with those since obtained during the present year, be sufficient to leave a surplus for the current year. Other expenditure under the same heading includes Hebburn, the completion of which station has been somewhat delayed, but is now practically ready for work. There are also some smaller items of expenditure for Felling, Whitley, Hartlepool and Thirsk, which places are about to be vigorously taken in hand. The item for provisional orders secured amounts to £7,504 16s. 4d., and includes areas in Yorkshire and in the colliery centres of Northumberland and Durham, some of which are under negotiation for an early start of operations. The plant already installed at the stations of Blyth, Spennymoor, Alnwick and Hebburn is capable of producing over a million units of energy per annum. Up to the present, there were connected and applied for an equivalent of over 24,000 8-c.p. lamps, exclusive of power supplies. The total number of provisional orders held or worked by the company was 24. Several of these, situated in the mining districts of Northumberland and Durham, are well grouped together, and it is proposed to supply such centres from a common generating or power station; in this way a great deal of capital outlay will be saved. With regard to the Whitley station, the directors expect to make an arrangement with the Newcastle Supply Co., whereby the necessity of erecting a generating station will be avoided; and seeing that the Yorkshire Power Co. is now about to commence operations, the directors hope to avail themselves of the proximity of one of their power stations to Handsworth, near Sheffield, for which place this company holds the lighting order. Thirsk and the smaller towns where coals are comparatively dear, and outside power not within reach, will be worked by plant driven by oil engines. With regard to Hartlepool, which the directors consider a satisfactory area, owing to the compact wiring network area, the company has secured the bulk of the public lighting, and expects also to obtain fair demand for power in addition to light. The free wiring system has been largely patronised, and the board anticipates a large further demand for it, especially in the colliery districts and wherever there are rows or groups of small houses.

After referring to the new capital which is to be raised, the Chairman formally moved the resolution, and it was carried.

Folkestone Electricity Supply Co.

The directors' report to December 31st last says that the company continues to make satisfactory progress. At December 31st, 1901, the equivalent of 32,532 8-c.p. lamps was being supplied, whilst at December, 1902, the number was 40,699 8-c.p. lamps.

There is a profit on the revenue account of £5,177 5s. 9d., which with the profits on installation work, &c., and £310 19s. 10d. brought forward, and after allowing for interest on debenture stock and bank charges on overdraft, shows a net balance for distribution, after allowing for the interim dividend at the rate of 4 per cent. per annum already paid, of £2,502 17s. 7d. Out of this the directors recommend the payment of a dividend at the rate of 6 per cent. for the half-year (making 5 per cent. for the year), which will require £1,500, and the placing of £800 to the reserve fund or a depreciation fund, thus leaving a balance of £204 17s. 7d. to carry forward. The directors have entered into an agreement with the local authority at Hythe for the working of their provisional order, and they are concluding negotiations with the District Council of Sandgate for the working of the Sandgate order. To provide the cost of the outlay in connection with the supply of these two districts and for further extensions in Folkestone and to pay off the bank overdraft, additional capital has been created in the shape of 10,000 5 per cent. preference shares of £5 each. A first issue of 5,000 of these shares was offered in January last to the shareholders and debenture stock holders of the company, and the issue was well received and was oversubscribed.

Brush Electrical Engineering Co., Ltd.

The directors' report for the year 1902 says that the profit and loss account shows a gross profit of £66,948 18s. 3d. After deducting general charges, maintenance, interest on debenture stock, and £6,500 carried to depreciation reserve fund, there remains a balance of net profit of £24,186 13s. 7d. In pursuance of the policy inaugurated last year, and for the same reason, the directors have decided to carry £5,000 to the general reserve fund out of the profits for the year. They therefore recommend that the balance of net profit be applied as follows:—6 per cent. dividend on preference shares, £18,000; to general reserve fund, £5,000; to balance carried forward, £1,186 13s. 7d.; equal £24,186 13s. 7d. Capital expenditure to the extent of £10,813 15s. 7d. has been incurred during the year on new plant and buildings. The obligation of the British Electric Traction Co., Ltd., to place 25,000 ordinary shares of the company at par has been cancelled in consideration of the £30,740 already advanced by that company under the agreement remaining as a loan at interest until June 30th, 1904, when, at the option of your directors, it may be either paid off or the British Electric Traction Co., Ltd., may be called upon to invest the amount in ordinary shares of the company at par. The company is, therefore, now free from the obligation to pay commission to the British Electric Traction Co., Ltd., for underwriting the 25,000 ordinary shares in question, and this item has been eliminated from the balance-sheet. The directors are of opinion that the employés' bonus fund, established by the company in 1889, no longer fulfils its object. They have, therefore, by virtue of the powers reserved to them under the rules and regulations of the fund, declared the same to be at an end. During the year under review the directors have given unremitting attention to the improvement of the organisation and to the extension of the business, and although sufficient time has not yet elapsed to admit of the full effect of their policy being felt, the balance-sheet now submitted shows that substantial improvement has been made. The company's facilities for the manufacture of steam and electrical machinery generally have been greatly strengthened during the year, and arrangements have been concluded enabling the company to make and supply steam turbines as well as polyphase generators and motors, all of the highest efficiency, and embodying the most approved modern practice. The output from the car and track shops has greatly increased. The contract and automobile departments started during the year have made good progress.

Gateshead and District Tramways Co.

The report for 1902 says that notwithstanding unfavourable weather the gross receipts amounted to £41,548. There is a net profit of £9,514, to which is added £3,316 14s. 4d. brought forward, making £12,830, which is applied as follows:—5 per cent. and 6 per cent. preference dividends, £5,241 3s.; ordinary dividend at 4 per cent., £4,847 4s.; depreciation and reserve fund, £2,000; carry forward, £742 10s. 4d.—£12,830. The expenses of operation have been reduced, and the directors hope to be able to make still further improvements in this direction. Five additional cars of large

carrying capacity have been purchased. The local and other rates amounted to £1,532 19s. 9d., being an increase of £840 1s. 5d. The total expenditure on new works chargeable to capital account during the year amounted to £12,817 6s. 3d., making the gross amount of capital expended on the undertaking £297,300 18s. 10d. The construction of the Wrekenton Light Railway will involve a further outlay of about £6,000.

1901.		1902.
M.	Route miles—	M.
4·63	Single line	5·13
4·89	Double line	4·89
9·52		10 02
6,172,166	Number of passengers carried	10,168,210
1·14d.	Average receipts per passenger	·956d.
0·65d.	Average expenditure per passenger	·786d.
72 37 p.c.	Proportion of expenses to receipts	77 p.c.
45	Number of cars in stock	70

The meeting was held last Friday at Donington House.

Greenock and Port Glasgow Tramways Co.

Mr. C. Shirreff Hilton presided at the meeting of this company. In the course of his speech he referred to a dispute with the Greenock Corporation respecting £1,300 which was claimed by the Corporation on account of electrical energy, but it was not admitted by the company and had been referred to arbitration. The point in dispute was that, under the lease, the company agreed to take a *minimum* of 500,000 units at 1½d. per unit, the price of all units consumed in excess of that number being left to subsequent agreement. The board held the view that the price for the additional units taken should be considerably under 1½d. On the other hand, the Greenock Corporation had thought it inexpedient to make any such reduction, and, pending the result of the arbitration, the full price had been included in the item. After referring to the different items in the accounts, he said he thought that the shareholders might be satisfied with the result of the first year of electrical working. The revenue amounted to £26,429, against £12,914, and the net profit to about £10,000, compared with only £1,936 in the previous 12 months. They had carried during 1902 more than 5,344,000 passengers, which was equivalent to, roughly, 60 times the population of Greenock, Gourock and Port Glasgow combined. The passengers in 1901 numbered 2,366,922, and in 1900 2,001,043.

Mr. F. B. Lea seconded the resolution.

British Electrical Superannuation Fund.—The annual general meeting of the members of this fund was held on Wednesday last week at Donington House, Norfolk Street, Strand, Sir C. Rivers Wilson presiding. The report has already been mentioned in our columns. Since the close of the period under review, the membership had grown from 145 to 157. The Chairman hoped that the fund would continue to receive the support, not only of the B.E.T. Co. and its associated companies, but of the electrical industry generally. The income for 1902 amounted to £2,785, and the invested funds had been increased to over £5,000. Their investments were well spread, and yielded a return of a little over 4 per cent. He concluded by referring to the valuable services of the secretary (Mr. W. G. Bond).

Liverpool District Lighting Co.—This company, whose annual report was given in brief in a recent issue, held its meeting at Liverpool on 19th inst., when Col. A. Hill Holme gave further evidence of the satisfactory progress that is being made. He stated among other things that they would probably be shortly increasing their capital by an issue of ordinary shares, which would be first offered to the existing shareholders.

Direct United States Cable Co.—Interim dividend of 3s. per share (at the rate of 3 per cent. per annum) for the quarter ending March 31st, 1903.

Stock Exchange Notices.—Applications have been made to appoint a special settling day in, and to grant a quotation to:—British Columbia Electric Railway Co., Ltd.—£175,000 4½ per cent. Vancouver power debentures of £100 each; 6,000 5 per cent. cum. perpetual pref. shares of £10 each, fully paid.

Robey & Co.—After writing off £5,000 for depreciation, there remains £12,640, from which £6,312 has to be deducted for debenture interest, and, with £2,849 brought forward from last year, a balance of £9,177 is available for division. Dividends of 6s. per share (3 per cent.) on both preference and ordinary shares are proposed, carrying forward £348.

Newcastle and District Electric Lighting Co.—The directors have decided to issue £30,000 debentures (4 per cent.). The debentures are offered at par to the present shareholders.

STOCKS AND SHARES.

Wednesday Evening.

Fresh records of flatness continue to be created by Consols, and the fall in the Funds is beginning to assume serious proportions. While there are substantial enough reasons to account for the weakness, the sustained drop is disquieting as well as depressing to almost every other market in the Stock Exchange. The fact that investment and speculative business has shrunk to infinitesimal proportions is sufficient to dispel any fear of the least semblance of decided alarm shaking investors' confidence in the certainty that affairs financial will right themselves in the long run. One of the most unpleasant factors now apparent is, of course, the increasing clamour raised on all hands for new capital, and the number of fresh issues, of all sorts and sizes, which we are promised for April, is of itself one cogent cause why Consols are so depressed.

In this connection it may be mentioned that the County of London and Brush Provincial Co. has a new second Debenture issue on hand. Reference was made to this last week, when we ventured to quote a high authority as saying that no fresh money would be wanted yet awhile. However, the underwriting prospectuses came out hot on the heels of this statement, and again it is established that to err is human.

With other investment departments so weak, it seems almost necessary to apologise for the continued hardiness of electrical supply descriptions. There are few fluctuations to chronicle quotably, but the tone of the market is good, and in many cases it is easier to sell shares than to buy them. Brompton and Kensington Preference have risen ¼, City of London Ordinary ½, the latter thereby recovering their dividend. South London Ordinary shares are within reach of 4, and the only decline in the list is furnished by Charing Cross Preference, which have fallen 5s, the City undertaking shares remaining unchanged. Brush shares had their rise prior to the issue of the report, which has made no difference to the prices. But the Second Debenture stock has widened out 5 points in the downward direction, and is now called 85 to 95, an absurdly wide margin.

Several of the provincial supply shares are in request, and prices show no disinclination to respond to the demand. Bromley (Kent) shares have hardened to 6 *ex* dividend, and the Debenture stock stands at 103½. Bournemouth and Poole Ordinary and Preference are 14 and 10½ respectively, Oxfords 5½, while Folkestone Ordinary command 6¼ and Hove 8. Calcutta shares remain at 7½, Electric Lighting and Traction of Australia Preference at 4, and Primitiva of Buenos Ayres Ordinary are 3⅜, and the Preference 4½.

The only alteration amongst Home Rails shows itself in Central London Deferred, the price of which is down a point. City and South London Ordinary, however, has really weakened a shade. Mersey Railway Consolidated Ordinary stock is inclined to brace up a little, notwithstanding the miserable report recently presented. The stock is now 14 to 16, and a company has been formed to finance the work of electrification that, it is hoped, will set the unfortunate Mersey Railway on its legs again.

Anglo-American stocks are the outstanding feature in the Telegraph market, the Deferred particularly distinguishing itself with a rise of a full point. Similar advances in the two other stocks are also to be noted, but the prices of these last are heavier, and can be moved more easily, despite the apparent paradox. Speculative purchases on a market bare of stock are responsible for the improvement, which has had a sympathetic effect upon Direct United States. The Anglo-American jump brought out a rumour to the effect that the company was thinking of amalgamation with the Direct United States concern, but there may be no truth in the suggestion, although, of course, it is not outside the pale of possibility. A full quarter's dividend is expected on Anglo "B," and it is thought that appropriations to reserve may soon cease; both bull points as regards the "A" stock." Eastern Telegraph securities have remained almost lifeless, and, with the exception of a 1 per cent. drop in Eastern Ordinary and Preference, prices are unchanged. A slight weakening is visible in West India and Panama shares, the Ordinary being ⅛ easier, and the Preference marking ¼ fall.

National Telephone stocks, throwing off their temporary dulness of last week, display renewed vigour, the Deferred being as much as 4 points to the good. The company's shares do not move, but the 3½ per cent. Debenture stock has followed the course of the Deferred in more leisurely style. Chili Telephone shares are ¼ better upon the gradual settlement of the republic after its rupture with the Argentine. The Welsbach reconstruction scheme is expected within the next few days, and possibly something more may be heard of that electric incandescent light which was to do so much for the company, but which, for some time past, has apparently borne cruelly literal testimony to Mr. Kipling's conception of "The Light that Failed." Welsbach proprietors would, we are sure, welcome warmly any new luminant that helped to make good profits for the undertaking.

British Insulated and Helsby Cables shares are both better on the report; otherwise the miscellaneous section exhibits no variation this week. The Marconi report is interesting, and the price of the shares is 2½ middle.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Mar. 18th.	Closing Quotations Mar. 25th.	Business done week ended Mar. 25th, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	97 —101	97 —101	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2½ — 3½	2½ — 3½	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3½%	61s.	60/6	49 — 52	50 — 53	51½	50½
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	92 — 94	90 — 95	94½	93
3,105,580	Do. do. do. Deferred	Stock	5s. %	2s.	1/-	8¼ — 8¾	9½ — 9¾	10	8½
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	..	4 — 4½	4½ — 4¾	..	..
13,333,300$	Commercial Cable	$100	8 %	8 %	..	160 —170	160 —170	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	90 — 93	90 — 93	90½	..
16,000	Cuba Telegraph	10	4½%	4 %	..	6½ — 7½	6½ — 7½	6¾	..
6,000	Do. 10 % Pref.	10	..	..	..	13¼ — 14½	13½ — 14½	..	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	2½ — 3½	2½ — 3½	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
60,710£	Direct United States Cable	20	3½%	3½%	..	9 — 10	9½ — 10¼	9¾	9¾
92,800£	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	121 —126	119 —124	128	119½
1,955,565	Do. 3½ % Pref. Stock	100	..	..	..	86 — 89	85 — 88	87	85
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	106 —109	106 —109	106½	..
300,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	..	11½ — 12½	11½ — 12½	12	11⅝
220,000£	Do. 4 % Deb. Stock	Stock	..	..	..	105 —108	105 —108	..	..
200,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	101 —104 %	101 —104 %	101½	..
180,227	Globe Telegraph and Trust	10	5½%	5½%	..	8¾ — 9¼	8¾ — 9¼	9 5/16	8⅝
180,042	Do. do. 6 % Pref.	10	..	..	..	12 — 13	12 — 13	12⅝	12 ⅛
180,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	..	25 — 27	25 — 27	..	..
66,800£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	..	37 — 41	37 — 41	38½	37½
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	100 —104	100 —104	..	..
72,680	Montevideo Telephone, Ltd., Ord. Nos. 1 to 72,680	1	2½%	2½%	..	¾ — ⅞	¾ — ⅞	..	..
86,492	Do. do. 5 % Pref., Nos. 1 to 86,492	1	..	..	..	1 — 1	1 — 1	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	98 —100	98 —100	99⅜	98½
1,966,667	Do. do. Def. Stock	100	..	..	4½%	69 — 71	73 — 75	73¼	72
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	..	..
250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼ — 5⅝	5¼ — 5⅝	5⅛	5 3/16
2,000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	95 — 98	97 — 99	99	98
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	101 —103	101 —103	102⅜	..
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	..	⅞ — 1	⅞ — 1	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,839	Reuter's	8	5 %	5 %	..	6¾ — 7¾	6¾ — 7¾	..	..
3,303	Submarine Cables Trust	Cert.	..	..	..	105 —115	105 —115	..	..
58,000	United River Plate Telephone	5	7 %	7 %	..	5⅛ — 5⅜	5⅛ — 5⅜	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅜ — 5⅛	4⅜ — 5⅛	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	103 —106	104 —107	..	..
16,609	West African Telegraph, Shares	10	..	..	..	3 — 4	3 — 4	..	..
30,008	West Coast of America, Nos. 1 to 30,000 and 53,001 to 53,008	2½	..	..	..	0 — ¼	0 — ¼	..	..
150,000£	Do. do. 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	96 — 99	96 — 99	..	..
267,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	..	11 — 12	11 — 12	11⅜	11⅜
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —104	101 —104	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	96 — 99	96 — 99	..	..
88,321	West India and Panama Telegraph	10	½%	..	..	9/16 — 11/16	9/16 — 11/16	..	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6½ — 7	6½ — 6¾	6⅝	6¾
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	4 — 5	4 — 5	4	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	99 —102	99 —102	98	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	3 — 4	3 — 4	3⅝	..
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	75 — 80	75 — 80	..	..
100,000	British Electric Traction	10	9 %	9 %	..	13½ — 14	13½ — 14	13⅞	13⅝
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	12 — 12½	12 — 12½	12⅝	12 7/16
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	124 —127	124 —127	126¼	..
100,000	British Insulated and Helsby Cables	5	15 %	10 %	10 %	7½ — 8	8 — 8¼	8	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5¾ — 6	5¾ — 6¼	5⅞	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —106	102 —106	105	104½
50,000	¶Browett, Lindley & Co., Ord.	£1	8 %	Nil	..	12/6 to 13/6	12/6 to 13/6	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	16/6 to 17s.	16/6 to 17s.	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	Nil	1 — 1¼	1⅛ — 1⅜	1 1/16	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	6 %	1⅝ — 2¼	1⅝ — 2¼	2	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	99 —102	99 —102	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	90 — 95	85 — 95	..	..
35,000	Callender's Cable Construction shares	5	15 %	20 %	..	13½ — 14½	13½ — 14½	14⅛	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5⅝ — 6	5⅝ — 6	5 15/16	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	108 —112	108 —112	111½	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	105 —108	105 —108	107	106⅝
494,093	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	103 —106	103 —106	105½	..
494,993	Do. do. Def. do.	Stock	..	4 %	4 %	108 —111	107 —110	..	..
1,330,000	City and South London Railway	Stock	1½%	2 %	3½%	75½ — 76½	75 — 77	76	75
85,000	Crompton & Co., Nos. 1 to 85,000	3	8 %	7½%	..	2½ — 3	2½ — 3	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	102 —106	102 —106	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	Nil	..	⅞ — 1	⅞ — 1	..	..
17,139	Do. do. "A" shares, 01—017,139	5	2½%	Nil	..	1½ — 2¼	1½ — 2¼	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	73 — 77	73 — 77	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	77 — 82	77 — 82	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	..	1½ — 2	1½ — 2	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	..	..	..	2½ — 3	2½ — 3	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	98 —101	99 —102	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	10 — 10½	10 — 10½	10	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	100 —103	100 —103	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	15 — 16 xd	15 — 16 xd	15⅝	15½
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5 — 5⅛ xd	5⅛ — 6 xd	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	107 —111 xd	107 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18½ — 19½	18½ — 19½	19	18½
300,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	101 —104	100 —103 xd	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	1½%	1½%	5⅛ — 5⅜	5⅛ — 5⅜	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10½ — 11	10½ — 11	..	..
7,500	Parker (Thomas), Ltd., Ord., Nos. 1 to 7,500	10	..	..	..	14½ — 15½	14½ — 15½	..	..
87,350	Telegraph Construction and Maintenance	12	17½%	20 %	20 %	35 — 39	36 — 39	38½	37½
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3⅛%	97 —100	97 —100	..	..

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
§ From Bradford Share List.
¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, ¼—¼.
National Electric Free Wiring, ½—1.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 13—14.
Do. do. Pref (£10 pd.), 10—11

Bank rate of discount 4 per cent. (October 2nd, 1902).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Mar. 18th.	Closing Quotations Mar. 25th.	Business done week ended Mar. 25th, 1903. Highest.	Lowest.
		‡							
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	1	..	..	..	¾— 1	¾— 1	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs. ..	100	..	..	..	120 —123	120 —123	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	5	6 %	8 %	8 %	10¼— 10⅝ xd	10¼— 10⅝ xd	..	..
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	9⅛— 10¼ xd	10 — 10¼ xd	..	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	9 — 9⅛	9 — 9⅛	9⅛	9⅛
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5⅛— 6	5⅛— 5⅞	5⅞	5⅞
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4⅝— 5⅛	4⅝— 5⅛	4⅝	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	104 —106	104 —106	106½	..
44,486	*Chelsea Electricity Supply, Ord.	5	5½%	4 %	4½%	6 — 6⅛	6 — 6⅛ xd	..	..
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	109 —112	109 —112	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	10	0 %	5 %	5 %	9⅛— 10⅜ xd	10 — 11 xd	10⅛	10⅛
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13⅛— 14⅛ xd	13⅛— 14⅛ xd	14	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	122 —127	122 —127	..	..
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	103 —106	103 —106	106	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000..	10	4 %	4 %	4 %	8⅜— 9⅛	8⅜— 9⅛	8⅝	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	6 %	..	..	12 — 13	12 — 13	12⅝	..
400,000‡	Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red ..	..	..	..	..	109 —112	109 —112	110	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	..	6⅜— 7	6⅜— 7	..	..
30,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6 — 6⅜	6 — 6⅜	6 13/16	6⅜
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	..	..	..	..	106 —109	106 —109	108⅝	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	10 %	10¾— 11⅛	10¾— 11⅛ xd	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	100 —103	100 —103	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	2⅛— 2⅜	2⅛— 2⅜	2⅛	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5⅛— 6 xd	5⅛— 6 xd	..	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red ..	Stock	..	..	..	100 —103	100 —103	101¼	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6½%	7½%	18⅜— 19½	18⅜— 19½	19¼	18⅛
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	108 —113	108 —113	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	98 —101	98 —101	..	..
10,852	Notting Hill Electric Lighting	10	7 %	6 %	6 %	14 — 15 xd	14 — 15 xd	15½	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15 — 16	15 — 16	15⅝	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	..	8½— 9⅜	8½— 9⅜	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	98 —101	98 —101	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	2½%	3 — 3½	3 — 3½	..	..
50,000‡	Do. do. 4% Deb.	100	..	..	..	88 — 93	88 — 93	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	1¾%	3⅛— 3⅝	3⅜— 4	3 13/16	3 11/16
30,000	Urban Electric Supply, Ord.	5	..	..	..	4⅛— 5⅛	4⅛— 5⅛	..	..
30,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4⅛— 5⅛	4⅛— 5⅛	5⅛	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	12 — 13	12 — 13	12⅝	12 1/16
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6½— 6⅝	6½— 6⅝	6⅝	..

*Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS. Wednesday, March 25th.

	CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	,, Nitric	per cwt.	22/-	..
a	,, Oxalic	per cwt.	82/-	..
a	,, Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	,, ,, ...	per ton	£30	..
a	Bleaching powder	per ton	£4 10	..
a	Bisulphide of Carbon	per ton	£15	..
a	Borax	per ton	£13	..
a	Benzole (90 %)	per gal.	7/-	..
a	,, (50/90 %)	per gal.	5/6	..
a	Copper Sulphate	per ton	£23 15	..
a	Lead, Nitrate	per ton	£24	..
a	,, White Sugar	per ton	£81	..
a	,, Peroxide	per ton	£27 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90% at 160° C).	per gal.	5/6	..
a	Potash, Bichromate, in casks ..	per lb.	9d.	..
a	,, Caustic (75/80%).. ..	per ton	£24	..
a	,, Bisulphate	per ton	£35	..
a	Shellac	per cwt.	119/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 5	..
a	,, Recovered	per ton	£5 10	..
a	,, Lump	per ton	£5	..
a	Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a	,, Crystals	per ton	£3	..
a	,, Bichromate, casks.. ..	per lb.	2½d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£148	..
b	,, Wire, in ton lots ..	per ton	£224	..
b	,, Sheet, in ton lots ..	per ton	£191	..
p	Babbitt's metal ingots	per ton	£42 to £143	..
c	Brass (rolled metal 2' to 12') basis	per lb.	7d.	..
c	,, Tube (brazed)	per lb.	9d.	..
c	,, ,, (solid drawn)..	per lb.	7¾d.	..
c	,, Wire, basis..	per lb.	7¼d.	..
c	Copper Tubes (brazed)	per lb.	9¼d.	..
	,, ,, (solid drawn) ..	per lb.	9¾d.	..
g	Copper Bars (best selected ..	per ton	£78	..

	METALS, &c. (*continued*).		Latest Price.	Week's Inc. or Dec.
g	Copper Sheet	per ton	£78	..
g	,, Rod	per ton	£78	..
e	,, (Electrolytic) Bars ..	per ton	£73	65/- inc.
e	,, ,, Sheets ..	per ton	£84	£3 inc.
e	,, ,, Rod ..	per ton	£74 10	£3 inc.
e	,, ,, H.C. Wire	per lb.	9d.	½d. inc.
f	Ebonite Rod	per lb.	8/-	..
f	,, Sheet	per lb.	5/-	..
n	German Silver Wire	per lb.	1/6	..
h	Gutta-percha fine	per lb.	8/-	..
h	India-rubber, Para fine	per lb.	3/8 to 3/9½	..
i	Iron, Charcoal Sheets	per ton	£18	..
i	,, Pig (Cleveland warrants)	per ton	52/6½	3d. inc.
i	,, Forgings, according to size	per ton	From £11	..
i	,, Scrap, heavy	per ton	47/6 to 50/-	..
i	,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£14	..
g	,, ,, Sheet	per ton	£13 7 6 to £13 10	5c. inc.
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£8 12 6	..
d	Mica (in ginal cases) small ..	per lb.	3d. to 9d.	..
d	,, ,, ,, medium	per lb.	1/9 to 2/9	..
d	,, ,, ,, large ..	per lb.	3/8 to 7/8	..
p	Phosphor Bronze, plain castings	per lb.	1/- to 1/2	..
p	,, rolled bars & rods	per lb.	1/- to 1/3	..
p	,, ,, strip & sheet	per lb.	From 1/2	..
o	Platinum	per oz.	£4	..
p	Silicium Bronze Wire	per lb.	9½d. to 1/-	..
i	Stee., Magnet, acc'd'g to desc'p'n	per ton	£68	..
i	,, ,, in bars		£15 to £40	..
g	Tin, Block	per ton	£136 to £137	30/- dec.
g	,, Foil	per lb.	1/6	..
n	,, Wire, Nos. 1 to 16 ..	per lb.	1/9½	½d. dec.
p	White Anti-friction Metals— "White Ant" brand ..	per ton	£42 to £62	..
j	Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7¾d.	..
j	,, 6 lea. Flax	per lb.	5¾d.	..
j	,, 3 ply 10 lbs. Russian ..	per lb.	4½d.	..
j	,, 10 lbs. Russian, single ..	per lb.	4¾d.	..
j	,, 180 lbs. Jute rove ..	per ton	£11	..
k	Zinc, Sh't (Vieille Montagne bnd.)	per ton	£26 15	..

Quotations supplied by:—*a* Messrs. G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Messrs. Thos. Bolton & Sons., Ltd.; *d* Messrs. F. Wiggins & Sons; *e* Messrs. Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* Messrs. James & Shakespeare; *h* Messrs. Edward Tull & Co.; *i* Messrs. Bolling and Lowe; *j* Messrs. Walter H. Hindley & Co., Ltd.; *k* Messrs. Morris Ashby, Ltd.; *m* Messrs. W. T. Glover & Co., Ltd.; *n* Messrs. P. Ormiston & Sons; *o* Messrs. Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RECEIPTS.

Locality.	Week ending	Receipts for the week. £	Receipts for the week. £*	Total to date. £	Total to date. £*	Miles open.	Miles open. *
Aberdeen	Mar. 21	825	+268	40,626	+10,261	—	—
Birmingham	,, 21	5,033	+276	57,939	+ 3,555	—	—
Blackburn	,, 20	670	+ 15	40,870	+ 4,921	12½	+1½
Blackpool and Fleetwood	,, 21	203	— 9	2,251	+ 214	7½	—
Bolton	,, 22	1,676	+334	82,752	+ 7,719	—	—
Bristol	,, 20	4,244	+150	—	—	28	—
Burnley	,, 21	672	+190	—	—	—	—
British Elec. Trac. Co.:—							
Barnsley District ..	Mar. 13	164	—	1,605	—	—	—
Devonport	,, 13	400	— 38	3,889	— 117	5	—
Dudley—Stourbridge..	,, 14	716	+ 53	6,981	+ 69	18⅝	—
Gateshead	,, 13	757	+125	8,246	+ 1,846	10½	+ ¾
Gravesend—Northfleet	,, 13	189	—	1,775	—	8	—
Greenock—Pt. Glasgow	,, 13	404	+ 37	4,103	+ 420	7½	—
Hartlepool	,, 13	219	+ 43	2,194	+ 471	6½	+2
Kidderminster	,, 13	105	+ 8	1,005	+ 89	4½	—
Merthyr	,, 13	180	— 24	1,743	— 186	3	—
Middleton	,, 13	241	—	2,299	—	8½	—
Oldham—Ashton ..	,, 13	525	+ 54	5,130	+ 595	8	—
Peterborough	,, 13	116	—	921	—	—	—

* Compared with the corresponding period of 1902.

Locality.	Week ending	Receipts for the week. £	Receipts for the week. £*	Total to date. £	Total to date. £*	Miles open.	Miles open. *
B.E.T. Co. (*continued*)—							
Poole	Mar. 13	253	+ 54	2,320	+ 495	3½	—
Potteries	,, 13	1,480	+ 64	15,125	+ 1,297	29½	—
Rothesay..	,, 13	39	+ 10	410	+ 112	—	—
Southport	,, 13	215	+ 71	2,157	+ 886	5½	—
South Staffordshire ..	,, 13	719	— 59	6,975	— 254	21½	—½
Swansea	,, 13	453	+ 46	4,457	+ 413	5½	—
Taunton	,, 13	46	— 8	489	— 39	1½	+1½
Tynemouth	,, 13	225	+ 47	2,107	+ 267	3½	—
Weston-super-Mare..	,, 11	25	—	247	—	2½	+2½
Wolverhampton Dist.	,, 13	353	+193	3,472	+ 1,961	10½	+8
Yorkshire Woollen Dist.	,, 13	138	—	458	—	6	—
Dover	,, 21	177	+ 8	2,001	+ 49	3	—
Dublin	,, 20	4,590	+318	48,294	+ 3,088	46	—
East Ham	,, 21	581	+190	19,278	+ 4,784	5	+ ½
Glasgow	,, 21	12,569	+1,408	514,781	+17,095	63	+12½
Newcastle	,, 21	3,075	+1,114	—	—	17	—
Sunderland	,, 22	1,009	+ 10	—	—	12	—
Central London Railway	,, 11	7,142	+318	88,869	+ 4,146	6½	—
City and S. London Ry	,, 12	3,039	+236	38,845	+ 2,561	6	+1½
Liverpool Overhead Ry.	,, 22	1,547	+155	17,993	+ 1,442	6½	—

THE MURRAY PRINTING TELEGRAPH.

(*Continued from page* 504.)

As the motor is kept constantly running, it is necessary to employ suitable means for preventing the rotation of the spindle, 21, when the latter is checked by the escapement, and for this purpose the drum device, shown in the back sectional elevation, fig. 12, is provided. Shaft 1, which is directly connected to the armature of the motor, is expanded at the outer end to two discs, 3 and 4, in which are two slots to hold springs 5 and 6 from moving sideways. Springs 5 and 6 are attached to the discs, 3 and 4, by adjusting screws, 7 and 16. Small pads of hard felt, 8 and 9, are riveted to the free ends of springs 5 and 6. These pads rub against the inner surface of a steel drum, 10. Attached by one end to the drum is a watch-spring, 11, the other end being attached to shaft 21. The drum is kept in place only by the attachment of the spring to the shaft. The rotation of the motor shaft, 1, causes the friction pads to keep spring, 11, wound up, thus supplying quick-acting power to drive the sprocket wheel. As the tendency of the spindle of the latter is thus to rotate, it will readily be seen that each time the spacing magnet is energised and de-energised, the movement imparted to the escapement permits the tape to be fed forward a distance equal to that separating two centre holes. On the other hand, when the punching magnet is operated, the tape is held stationary, and a perforation is made by means of the punch, 38. The perforations are thus made on one side of the centre holes only. Fig. 13 shows the letters of the received alphabet, the broken lines underneath the perforations representing the received impulses. Mr. Murray has succeeded in obtaining a speed of 150 words per minute on this recorder.

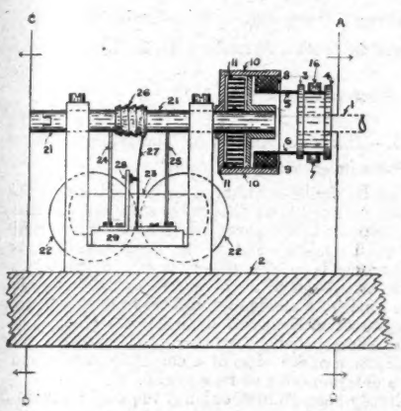


Fig. 12.

A very ingenious device previously referred to as a tape-stopping relay, is fixed in the space between the punching mechanism and the steel drum. This relay consists of an electro-magnet, 22, the armature, 23, of which is supported by two flat strips of metal, 24 and 25, attached at their lower extremities to a spindle which works between two pivots. The armature is controlled by a small spiral spring. Between the upper ends or cheeks of these flat strips, 24 and 25, is inserted a light spindle carrying a small disc, the periphery of which is bevelled. The extremities of the spindle project through the cheeks of 24 and 25, and work freely in the holes provided for the purpose. A spiral spring encircles the spindle between the right cheek and the disc, tending to keep the latter against the left cheek. When the armature is not attracted by coils, 22, the disc engages a worm, 26, fixed on 21. The thread of the worm consists of five turns, the rotation of which causes the disc and spindle to be moved bodily sideways towards the right cheek. During its traverse, the disc catches the free end of a fine flat spring, 27, pushing the latter from the contact post, 28. Both of these contacts are mounted on the ebonite block, 29, and are so connected as to open the spacing magnet circuit when the disc separates the contacts, thus stopping the tape feed mechanism. When the coils of the relay are again energised, the armature, 23, is attracted, and the disc is smartly withdrawn from the worm. The pressure of the spiral spring encircling the spindle then causes the disc to fly back against the left cheek, freeing 27 and allowing it to again make contact with post 28, thus bringing the spacing magnet coils again into operation. The function of the tape-stopping relay is thus to allow the tape-feeding mechanism to start immediately the coils are energised by the arrival of main line signals, and to stop the feeding when the main line signals cease for more than two or three seconds.

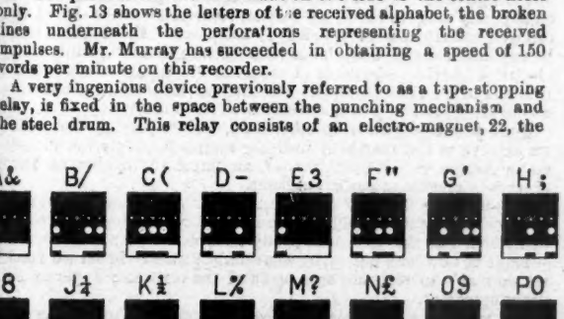


Fig. 13.

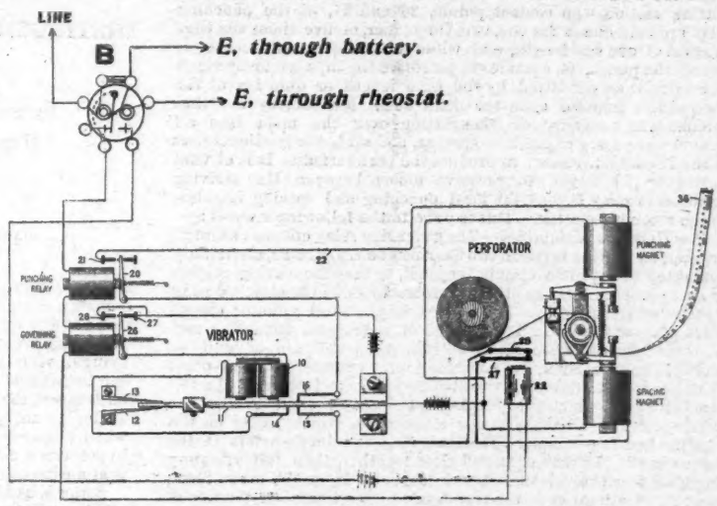


Fig. 14.

Receiving Vibrator.—As in the case of the transmitting vibrator this consists of an iron reed fixed at one end and free to vibrate at the other. Movable weights are applied at the free end, and by varying their position and size, the rate of vibration may be changed. Three specially designed flat springs are used for the contact points, two of which are on one side, and one on the other, their pressure being regulated by adjustable screws. By these means firm electrical contacts may be obtained during the vibration of the reed. The feature of this instrument, however, is the action of the resilient stops fixed at the free end. Under normal conditions, with this electro-magnet and circuit operated by break points carried by the reed, an increase of current resulting in increased magnetic effort will decrease the rate of vibration, and conversely a decrease of current, resulting in decreased magnetic effort, will accelerate the rate of vibration. This is believed to be due to eddy currents generated by the magnetic field of force and the movement of the reed in such field. The action described, while it has a damping effect, is of no practical use as a means of regulation for the work to which the reed is here put, because of its exceedingly limited range. It is necessary, in maintaining unison, to have a considerable range of variation in the speed of this reed, such variation in speed to be attained in response to variation in the length of current impulses of uniform strength.

To secure this result, there is placed at or near the free end and upon the opposite sides of the reed these resilient stops, shown at 12 and 13 (fig. 14). These springs receive the reed on each side with a cushioning effect and impart an initial return movement. In explanation of this result it is to be recalled that the rate of vibration of a reed varies with its length, mass, and the distribution of such mass. Increase of current in the motor magnet circuit increases the amplitude of vibration without varying the speed beyond the slight electro-magnetic damping effect already described. The energy imparted to the reed by the motor magnet is dissipated by the air resistance and molecular friction in the reed; an increase in the propelling energy brings a corresponding increase in the dissipation noted. Therefore, while the amplitude of vibration is widened, the speed is not increased. If fixed limiting stops be provided, to limit the amplitude of vibration, the energy of the reed cannot then be dissipated in the manner first described to the same extent, and there results an increase in the rate of vibration, while a portion of the energy imparted to the reed is dissipated in heat generated at the point of impact. To avoid this loss and further increase the rate of vibration, the energy, which would otherwise be lost at a rigid contact, is stored in the resilient devices, 12 and 13, already referred to, to cushion the impact of the reed, and impart an initial return movement. By this expedient, the movement of the reed is rendered smooth and uniform; it is freed from the interference due to the impact with a rigid stop, which acts to jar and disturb the

normal rate of vibration, and its rate may be varied by varying the current impulses.

In order to increase or decrease the currents in the circuit of the vibrator coils, external adjustable resistance coils are provided, as shown in the diagram, fig. 1.

Condensers and Resistances.—This apparatus, which is shown on the extreme right of the diagrams, figs. 1 and 2,* is used to prevent sparking at the various contact points to which it is connected. The condensers have a capacity of ·5 or 1·0 mf., and are each joined in series with 300$^{\omega}$ resistance.

As the remainder of the apparatus shown in fig. 1 is of the ordinary Post Office pattern employed on duplex circuits, it is perhaps too well known to need description here.

Action of receiving Apparatus.—For the sake of simplicity in describing the action of the receiving portion of the apparatus a skeleton diagram illustrating the principal connections is given in fig. 14. As the reed, 11, vibrates, the electric impulses in the spacing magnet circuit permit a steady progressive movement of the tape, 36, provided the line currents are indirectly operating the tape stopping relay, 22, so that the contacts, 27 and 28, are kept closed. Upon the arrival at B of an impulse of current from the transmitting station, the contact points, 20 and 21, of the punching relay are held closed for one, two, three, four, or five times the time interval of one dot length, and while this relay circuit breaker is closed, the punch, 34, operates to perforate the tape as many times successively as permitted by the time length or duration of the transmitted impulse upon the main line. Mr. Murray has thus avoided the necessity of transmitting over the main line all impulses necessary to produce spacing, and all but a fractional part of the impulses necessary to produce the perforations. It is of vital importance, however, to preserve unison between the arriving impulses in relay B, and the local punching and spacing impulses at the receiving station. This is done in the following manner:—

How Unison is Maintained.—The governing relay operates a circuit breaker, 26, moving between two fixed contacts, 27 and 28, electrically connected to the same circuit terminal, so that the moving contact in going from one to the other, operates to open the circuit during its time of transit only. This break in the local vibrator circuit takes place at the beginning and end of each signal from line, and as these signals arrive at a uniform rate, and are of unit or multiple unit duration, the governing relay operates its break-point at uniform unit intervals, or multiples of these intervals. In the same circuit in which this break-point operates, there is also the break-point, 14, of the vibrator magnet, 10, which works on the familiar buzzer principle. There are thus two break-points in the same circuit. If they open and close together, then full vibratory impulses flow through the vibrator magnet. If, on the other hand, the rate of vibration of the reed tends to accelerate, or the rate of the arriving current signals tends to lag, then the two breaks occur more or less alternately, and consequently less current gets through, the impulses are clipped, and the rate of vibration of the reed is reduced. In practice the receiving vibrator is set to go 1 or 2 per cent. faster than the rate of the arriving signals, and then the governing action of the two interfering break-points on the same circuit results in the establishment of a steady dynamic balance between the accelerating tendency of the reed and the retarding tendency of the arriving main line signals. By this arrangement the necessity for sending correcting impulses over the main line to secure synchronism is avoided, the correcting impulses being obtained locally with the co-operation of the line signals themselves.

Unison Diagram.—A diagram illustrating the relative position of the current impulses in securing unison is given in fig. 15. This shows a section of received tape in which appears the word "Paris," the division between the letters being marked with a dotted line. Below the line of the tape are shown the corresponding conditions of

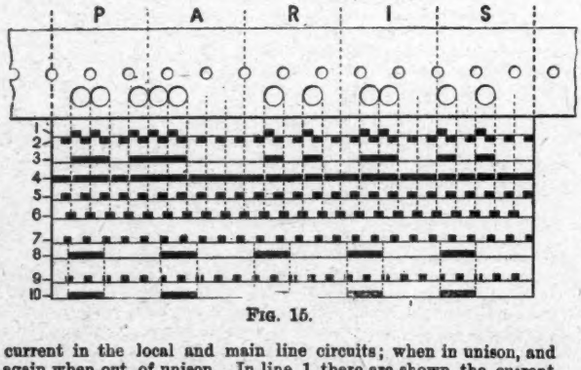


Fig. 15.

current in the local and main line circuits; when in unison, and again when out of unison. In line 1 there are shown the current impulses in the punching magnet circuit effective to produce the perforations shown on the section of tape; line 2 shows the current impulses in the local spacing circuit; at line 3 are shown the main line impulses due to the operation of the automatic transmitter effective to produce the perforation in the tape represented; at 4 is shown the operation of the armature of the governing relay, the unshaded divisions representing the "armature transit time," and the relative position of the armature transit with respect to the impulses in the main and local circuits; at line 5 are shown the impulses in the motor magnet circuit which operate to drive the reed; these impulses are shown as in unison with the main line and local circuit impulses. In line 6 are shown the same motor magnet circuit impulses out of step, or out of unison. The continuous operation of the unison device is best illustrated in the actual record taken upon a chemically prepared paper tape with a pair of iron pens, one in the local circuit and one in the main circuit; the pens were arranged side by side; line 7 shows the record of impulses in the motor magnet circuit; line 8 shows the main line impulses, the action of the armature of the governing relay having been suppressed. In lines 9 and 10 the same means are employed to render graphic the impulses in the two circuits, and the operation of the transit of the armature bar 26 of the governing relay is also apparent in clipping the local circuit impulses, and thus curbing their motive power effect on the reed. There is thus established a continuous "dynamic balance" between the tendency of the reed to accelerate its speed and the tendency of the line signals to retard its speed.

(*To be concluded.*)

* Figs. 1 and 2 in the first portion of this article (March 13th) were accidentally transposed.—Eds. Elec. Rev.

INSTITUTION OF ELECTRICAL ENGINEERS.

ON ELECTRONS.

By Sir Oliver Lodge, F.R.S., Vice-President.

(*Paper read in London, November 27th, 1902.*)

(*Continued from page 507.*)

Part VI.—Electric Theory of Matter.

Estimate of Size of Electrons.

On the hypothesis that the flying or vibrating fragment is a material corpuscle charged with electricity, so that it has a duplex constitution and a compound kind of inertia, part material and part electrical, no further progress can be made. But on the hypothesis that the flying or vibrating particle is an electron—a charge of electricity and nothing else—a constituent of an atom but with no material nucleus—so that the whole of atomic properties are to be considered as due to an aggregate of electrons of opposite size [? sign], of which one or two are comparatively free and detachable—on this hypothesis a determination of the mass of a corpuscle carries with it as a consequence a determination of its size also.

Because, as has already been pointed out, any required amount of self-induction can be conferred on a wire by making it fine enough, and any required amount of energy can be conferred upon an electric charge by making it concentrated enough. The energy at a given speed of motion will be proportional both to the quantity and the potential, and the latter can be made as great as we please by taking the size of the body possessing the charge extremely small.

It is the intense region of force close to the wire or close to the charged particle which is the effective region; and so, as stated, a knowledge of the mass or kinetic energy at a given speed suffices, on a purely electric theory of matter, to determine the size of the electron constituents of which it is composed. For whether there be any intrinsically material inertia or not, there certainly is an electrical inertia. The cause of it in the electrical case is known: it is due to the reaction of the electric and magnetic fields during acceleration periods, and is denominated self-induction.

Quite possibly there is no other kind. Quite possibly that which we observe as the inertia of ordinary matter is simply the electrostatic inertia or self-induction of an immense number of ionic charges or electric atoms or electrons.

This is by far the most interesting hypothesis, because it enables us to progress, and is definite. The admixture of properties, partly explained, viz., the electrical, partly unexplained, viz., the material—lands us nowhere, unless by some only partially imagined means we were able to estimate how much of the corpuscle appertains to each ingredient.

The mass of a corpuscle has been measured at something akin to $\frac{1}{1000}$ of an atom of hydrogen, and its charge as 10^{-10} electrostatic unit. This amount of electricity will have that amount of inertia if it exists over a sphere of radius 10^{-13} centimetre, but not otherwise. Consequently we may assume the size of the electron to be of the order 10^{-13} centimetre in diameter; or $\frac{1}{100000}$ of the linear dimension known as molecular magnitude, viz., 10^{-8} centimetre.

The calculation of order of magnitude is quite simple, for all ordinary speeds, because, for them—

$$m = \mu e^2/a,$$

$$\therefore a = \frac{e}{m} \cdot e = 10^7 \times 10^{-20} = 10^{-13} \text{ centimetre},$$

though it might with some data be estimated as small as 10^{-14}.* With a size like that the penetrating power of cathode rays is explained, especially if the atoms of matter are themselves composed of such minute particles; for the interspaces will be enormous compared with the filled-up space, and a point can penetrate far into such an assemblage without striking anything.

The mean free path of a particle is a question of probability. In a space containing n_1 obstacles to the unit volume, a space Δx will contain $n = \Delta x\, n_1$ of them, and the chances of a collision while one of them travels a length x will be approximately their combined

* See Lodge in the *Electrician* for March 12th, 1897, Vol. 38, page 664.

areas as targets compared with the total area available for both hit or miss—

$$\frac{n\pi a^2}{A} = a\,x = \frac{n}{\bar{x}},$$

where $\bar{x}$ is the "mean free path," or average distance travelled by any one particle without a collision with another, and a the number of encounters while travelling unit distance. But in saying this we are ignoring the forces between the particles, and are not considering a swing round as a collision.

So, as regards order of magnitude—

$$\bar{x} = \frac{A\,x}{n\pi a^2} = \frac{1}{n_1 \pi a^2} = \frac{d^3}{\pi a^2},$$

with a factor $\frac{2}{3}$ or $\sqrt{2}$ omitted which a completer theory would give; where d^3 is the cubic space allotted to each particle, while $\frac{4}{3}\pi\left(\frac{a}{2}\right)^3$ is the actual bulk of each.

Therefore

$$\frac{\bar{x}}{a} = \frac{\text{total space occupied}}{\text{eight times the aggregate volume of the particles}},$$

a statement sometimes quoted as Loschmidt's theorem.

Hence the mean free path can be determined by considering how much space the substance of all the electrons in an atom occupies, as compared with all the space which the atom occupies itself. In other words, we have to consider what the size 10^{-13} for an electron's diameter means, as compared with the size 10^{-8} for an atom's diameter. In the solar system the diameter of the earth is $\frac{1}{20000}$th part of the diameter of its orbit round the sun. Consequently if the earth represented an electron, an atom would occupy a sphere with the sun as centre and five times the distance of the earth as radius.

In other words, if an average atom is composed of electrons, they are about as far apart in that atom in proportion to their size as the planets in the solar system are in proportion to their size.

In an atom of hydrogen there are roughly 1,000, or say more exactly 700 electrons in order to make up the proper mass.

In an atom of sodium, which is 23 times as heavy, there must be about 15,000 electrons.

And in an atom of mercury there must be over 100,000 electrons.

Consider then an atom of mercury containing 100,000 of these bodies packed in a sphere 10^{-8} centimetre in diameter. One would think at first they must be crowded; but there is plenty of room. Each electron is only 10^{-13} centimetre across, and there are only about 50 of them in a row along any diameter of the atom; hence the empty space inside the atom is enormously greater than the filled spaces. At least a thousand times greater in linear dimension, or a thousand million times greater in bulk.

The whole volume of the atom is 10^{-24} c.c., the aggregate volume of all the electrons composing the atom is $10^5 \times 10^{-39} = 10^{-34}$ c.c, consequently the space left empty is 10^{10} or ten thousand million times the filled space.

Even inside an atom of mercury, therefore, the amount of crowding is fairly analogous to that of the planets in the solar system. For though the outer planets are spaced further apart than the inner ones, they are also bigger, to practically a compensating extent.

Now, going back to what is sometimes called Loschmidt's theorem in the kinetic theory of gases, obtained roughly above—

$$\frac{\text{mean free path}}{\frac{1}{2}\text{ diameter of particle}} = \frac{\text{volume of space available to particles}}{\text{combined volume of all their substance}}$$

we have reckoned the latter fraction, in the inside of an atom of mercury, as—

$$\frac{\frac{4}{3}\pi \times (10^{-8})^3}{100{,}000 \times \frac{4}{3}\pi\,(10^{-13})^3} = \frac{10^{-24}}{10^5 \times 10^{-39}} = 10^{10}.$$

Hence the mean free path of an *electron* inside an atom of mercury will be comparable to 10^9 times the size of an electron, i.e., it will be 10^{-4} centimetre; that is, it may get through on the average the substance of some 10,000 mercury atoms in a row without collision.

In any other less dense substance it will go further. The actual *distance* thus travelled by corpuscles plunging into a dense metal is very small, only the thousandth part of a millimetre on the average, and it need by no means necessarily be a straight line; so a target of platinum succeeds in stopping them fairly near its surface, and enables the X-rays generated by the shock fairly to emerge. Some corpuscles will be stopped more suddenly than this, and some will travel further, but 10^{-4} centimetre is about the average distance travelled in a solid as dense as platinum.

This distance, however, gives no notion of the value of the negative acceleration during a collision, because the greater part of the thousandth of a millimetre is free flight; the stoppage occurs only as the last episode of that flight, viz. at the instant of collision. The colliding masses are 100,000 to 1, so the change of velocity at impact could be estimated; but the impact will really be more of an astronomical or cometary character, and the effect is analogous to the entrapping of comets when they pass near a planet, thereby rendering them permanent members of the solar system.

The *ordinary* behaviour of a foreign comet, which comes and goes, may be called a collision with, and rebound from, the sun; for although there is no real encounter of main substance, that is what it would appear like if it could be seen from the depths of space; and the two branches of the comet's hyperbolic orbit would look like straight lines of approach and recession.

Comets which happen to pass very near a planet, however, are deflected, swirled round, and often virtually caught by that planet receding only with an insignificant differential velocity which is unable to carry them away from the attraction of the sun; into which they often drop. Or if they do not actually drop into it, they will continue to revolve round it in an elliptic orbit, becoming a member of the solar system, and liable ultimately to be degraded into a swarm of meteors.

This is the sort of process known to occur in astronomy, and circumstances not unlike that may attend the encounter or apparent collision of a furiously-flying comet-like electron with part of the massive system of an atom.

The stoppage, therefore, will occur well within the limits of atomic magnitude, 10^{-8} centimetre; and so the acceleration will be of the order $\frac{u^2}{2l} = 10^{26}$ c.g.s., and the force needed thus to stop even a single electron will be the tenth of a dyne.

No wonder that violent radiation-effects are produced. The "power" required to stop an electron, flying with one-thirtieth of the speed of light, inside a molecular thickness, can be estimated thus—

$$\text{energy} \div \text{time} = \frac{1}{2} m u^2 \cdot \frac{u}{2l} = 10^{-27}(10^9)^3\,10^8 = 10^8 \text{ ergs per second};$$

or thus—

$$F\,l \div t = \frac{1}{2} F\,u = 10^{-1} \times 10^9 = 10^8 \text{ again},$$

which is equivalent to 10 watts. (Though the time it lasts is only the 10^{-17} part of a second.)

But only a small fraction of this goes into radiation. The radiating power can be estimated thus, from Larmor's expression for it, as given in Appendix G, Part IV.:—

$$\frac{\mu e^2}{v}(\dot{u})^2 = \frac{10^{-40}}{10^{10}} \times 10^{52} = 100 \text{ ergs per second}.$$

The rest therefore, it would appear, must take the form of heat.

It is worth considering what circumstances would give radiation an advantage over heat, and *vice versâ*. Because sometimes conspicuously the target gets heated, and sometimes X rays are emitted. Let u be the speed and l the distance of stoppage, then—

$$\dot{u} = \frac{u^2}{2l},$$

then the force required to stop it is—

$$m\dot{u} = \frac{2\mu e^2}{3a}\frac{u^2}{2l}.$$

The "power" of the blow is—

$$\tfrac{1}{2} F\,u = \frac{\mu e^2 u^3}{6\,a\,l},$$

whereas the radiation power is—

$$\frac{2\mu e^2}{3v} \cdot \left(\frac{u^2}{2l}\right)^2 = \frac{\mu e^2 u^4}{6\,v\,l^2};$$

therefore $$\frac{\text{radiating power}}{\text{total power}} = \frac{a}{l} \cdot \frac{u}{v} = \frac{2a}{vt},$$

where t is the time of stoppage, and v is the velocity of light.

So effective radiating power depends chiefly on very sudden stoppage, and on the speed being near that of light. If the velocity is a tenth that of light, and if an electron can be stopped in something like its own diameter, about 10 per cent. of the energy will go in radiation, and the rest will take other forms, presumably heat.

As the velocity diminishes, more and more of the energy takes the form of heat; which agrees with the fact that at moderate vacua the target gets red-hot.

The ratio of the radiation power to the total power is as the dimensions of an electron to the distance light would travel during the period of the stoppage. So to get *all* the energy radiated it is necessary to stop a pellet moving with a tenth the speed of light in something like a tenth of its own diameter.

Justification for Electric View of Matter.

But now what justification is there for the extraordinarily far-reaching hypothesis that the electrons constitute matter, that atoms of matter are composed of electric charges, that the fundamental inertia-property of matter is identical with self-induction?

There is the reasonable philosophical objection to postulating two methods of explaining one thing. If inertia can be explained electrically, from the phenomena of charges in motion, it seems needless to require another distinct cause for it also. But this is not all that can be said; it is quite possible that direct experimental proof will be forthcoming before long. A method suggested by Prof. J. J. Thomson had reference to the proportion of radiation to thermal energy developed when corpuscles encounter a target which suddenly stops them. In so far as they consist of non-electric matter they would produce only heat by their dead collision, without any direct generation of ethereal waves. In so far as they consist of electric charges they would disperse a certain amount of radiation energy; and so the proportion of radiation to heat might afford a criterion.* Hitherto, however, no adequate measurements have been made in this direction.

But there is another more likely avenue to a conclusive result. We know that when an electric charge moves with a speed approaching that of light, its inertia is theoretically no longer constant, but rapidly increases and becomes infinite when the light velocity itself is reached, at least on the orthodox and accepted theory; and rather complicated and not quite accordant expressions for this high speed inertia have been calculated by several mathe-

* See J. J. Thomson, *Phil. Mag.*, April, 1899, p. 416.

matical physicists. See Appendix K for a discussion of this difficult subject.

It is possible that in certain cases of the production of cathode rays a speed not far short of that of light may be reached, and the increased inertia observed. Such an experimental determination has been seriously and quite recently undertaken by Prof. Kaufmann,* who employed the method indicated above (Part III.) of comparing simultaneously the electric and the magnetic deflection of the same set of rays submitted alternately or simultaneously to an electric and a magnetic field. Thus the velocity and the e/m ratio are both known, and Kaufmann concluded that when the speeds approached perceptibly near the velocity of light the electro-chemical equivalent m/e increased by just the amount required in accordance with pure electric theory—the theory which attributes the whole of inertia to electric influence. There appeared to be no quantitative room for any extra inertia, such as that of an inert particle of non-electric matter travelling with each projectile, retaining its inertia constant at all speeds, and so contributing nothing to the rise of inertia perceived when the speed approaches within hail of that of light.

It is too soon to be sure whether these results are trustworthy or not. The attempt is brilliant, and it can hardly be doubted that before long, evidence will be forthcoming on this and on other lines, which will enable us to accept or reject the hypothesis of the electric nature and unification of matter.

Meanwhile the hypothesis is in itself so probable that it is justifiable to attempt to look ahead and observe some of the consequences of the view that all atoms of matter are built up of the same fundamental units, and are composed of aggregates of a definite number of variously grouped negative and positive electrons, arranged in kinetic patterns and keeping apart by reason of the vigour of their own orbital motions.

At first it is not easy to do more than imagine the electrons to be statically grouped into regular patterns; arranged it may be in triangular or square or hexagonal order; with other allied three-dimensional possibilities familiar to students of crystallography. See, for instance, William Barlow, *Brit. Assoc. Report* 1896, p. 731; also Lord Kelvin, *Phil. Mag*, March, 1902, and elsewhere.

(To be continued.)

DINNER OF THE LONDON ELECTRICAL CONTRACTORS' ASSOCIATION.

The second annual dinner of the London Electrical Contractors' Association was held on Thursday last week at the Holborn Restaurant; Mr. A. Rasbleigh Phipps, President, took the chair, and about 250 members and guests attended, almost filling the "King's Hall." Among those present were Colonel Crompton, Mr. J. Swinburne (Pres. I.E.E.), Mr. W. G. McMillan (Sec. I.E.E.), Mr. W. B Esson Mr. Wallis-Jones, Mr. F. H. Nalder, Mr. Claud Hill, Mr. Stuart Russell, and other well-known engineers, both consulting and manufacturing, in addition to the members of the Association.

The dinner, of course, was excellent; it was accompanied by a capital programme of music performed by the "Bijou" orchestra, conducted by Mr. J. Pougher. After the President, with commendable brevity, had proposed the loyal toasts and these had been duly honoured, Mr. Phipps pledged the "London Electrical Contractor's Association." He pointed out that while last year there were 60 firms in the combine, that number had now been doubled. A standing committee had been appointed to deal not only with trade discounts, but with trade irregularities of all kinds. The President protested earnestly against Clauses 63 and 64 of the L.C.C.'s General Powers Bill, which are intended to authorise retail trading and the wiring of houses by municipalities, who, working at or under cost price, threatened to set up a ruinous competition with their ratepayers. Although vigorous action had been taken to oppose the Bill, only 10 per cent. of the contractors, whose pockets would be most severely affected, responded to the call. Mr. Duncan was organising a system of workmen's certificates, whereby it was hoped to eliminate all but the genuine skilled wiremen.

Next, Mr. W. R. Rawlings, President of the National Electrical Contractors' Association, proposed "The Institution of Electrical Engineers," and expressed the hope that when that body built itself a home it would remember its early days, and find room for the Contractors' Association, as the Civil Engineers had done for it. Mr. Rawlings, in the name of the Contractors, loyally accepted the new wiring rules, and said he thought that even the adviser of the leading fire office would be satisfied with them. In reply, Mr. J. Swinburne, President of the Institution, said he hoped that the I.E.E. would afford hospitality to the Contractors, but could not promise free coffee. He described various functions supposed to be normal to the Institution, such as the standardisation of machines (which involves the suppression of consulting engineers), and the overworking of the secretary; but the main object of its existence, he thought, was, like that of the Contractors' Association, to promote unity among the members.

Mr. W. W. Strode, with a neat speech, toasted "The Visitors," and Mr. H. Bland (Past.-Pres. Northern Section N.E.C.A.), in reply, expressed his pleasure at the progress of the London Association, and the hearty enjoyment of the evening's entertainment by the visitors. Mr. W. B. Esson also replied, and wished the Association every success, hoping that membership would become a guarantee of good work. He appealed to the members to support home manufacturers in preference to foreigners, and declared that there ought to be not hostility, but a firm union between manufacturers and contractors.

The toast of "The Electrical Engineer Volunteers" was appropriately spatchcocked into the programme at this point, being proposed by Mr. Passmore Edwards, and responded to by Col. Crompton. Finally, Mr. W. R. Woodward (Past-Pres. London E.C.A.) proposed the health of "The President," in eulogistic terms, and Mr. Phipps briefly acknowledged the compliment.

The toasts were interpersed with songs by Messrs. Cassidy, Davis, Fowler and Barnard.

* See *Comptes Rendus* for October 13th, 1902.

SOUTH AFRICAN NOTES.

[From Our Special Correspondent at Johannesburg.]

Dundee, Natal.—A prospectus is now being issued by the Dundee Electric Light and Power Co, Ltd. This company proposes to acquire the business now being carried on by Messrs. Collins, Kessler & Co., Pietermaritzburg. The capital is registered as £10,000, of which £8,600 goes to buy off the old company's works, plant, stock, goodwill, and also includes a concession from the Dundee Corporation to supply the town with current for electric light and power purposes. This leaves £1,400 for working capital.

Barberton.—The Board of Health have decided to petition the Council to sanction the electric lighting of the town. The telephonic and telegraphic arrangements of the district are also being given some attention at present.

Krugersdorp.—The Board of Health have decided to approach the Government for a loan of £8,000 to instal an electric light station in the town.

Ladysmith.—Mr. J. S. White, of Durban, has been appointed the borough electrician for Ladysmith.

ELECTRICITY SUPPLY FOR SMALL TOWNS AND VILLAGES.

At the meeting of the Leeds Local Section of the I.E.E., held on March 19th, a paper was read by Mr. A. B. Mountain on the above subject. After referring to the comparatively small progress which has been made in the lighting of small towns and villages, the lecturer considers this largely due to difficulties and misconceptions which are tending to impede the introduction of electricity, and proceeds to consider these.

The first difficulty is the want of enterprise or energy which is noticeable in all small places. This feeling of apathy is encouraged by the local gas companies, who are naturally in opposition to the rival undertaking.

The second difficulty is the supposed large initial outlay of capital necessary to construct works, the very general idea being that such small works must charge a high price per unit, and will therefore not be carried on profitably; but with care in the selection of a system, and in designing the works and distributing mains, financial success can be assured even on the smallest scale, and the initial capital outlay should be proportionately less than in a large town where one is compelled to construct works and lay mains of sufficient size to meet the demand which is certain to arise in future years. Then again, it is wrong to assume that small works cannot sell electricity profitably at a reasonable price per unit. Many small places under the control of companies and local authorities charge at the rate of from 4d. to 6d. per unit, and, where the supply is derived from collieries, mills, local electrical engineers, &c., from 3d. per unit upwards.

Also the charge for gas in small towns is usually much higher than in large ones, and it is usually found that electricity at 4½d. per unit will be adopted in preference to gas at 2s. 6d. per 1,000 cb. ft.

The third point against local enterprise is the idea that the power companies will eventually supply all such small towns and villages. However, a comparison of the plant and supervision required in the two cases leads the lecturer to the conclusion that this is hardly practicable, and even in cost the power company would, in accordance with the latest published information, charge 2½d. per unit, whereas it could be generated by steam or oil engines at from ½d. to 1d. per unit.

The fourth, and perhaps most usual, difficulty is the cost of obtaining the necessary Parliamentary powers, and a further dislike to the stringent regulations of the Board of Trade and the Local Government Board.

That the cost of obtaining a provisional order must be charged to the rates, and that the repayment of borrowed money must commence immediately, is a serious point upon which some concessions might be made by the Local Government Board; and when it is considered that, in the case of tramways, one or two years are allowed for construction, and that the full revenue from a tramway system

commences at once, whereas the revenue from an electric supply undertaking can only grow gradually, it will be agreed that local enterprise is not encouraged.

Engineering Difficulties.

There are in Great Britain and Ireland about 500 small towns, and between 2,000 and 3,000 villages, and very few of these have any electricity supply undertakings.

The chief points of consideration for engineers are:—

1. The probable number of consumers and consuming devices which will be connected within two or three years, and the ultimate maximum development.

2. The maximum demand which the generating plant will be required to supply.

3. A suitable position for the generating station, the form of motive power and system of generation.

4. The best method of distributing the supply, and the connection of consumers.

Nothing but experience will enable one to estimate the first point correctly; obviously the lower the price the quicker will consumers become connected, and this is the better course to adopt, although it may result in a loss for the first year or two.

It will usually be found that the majority of premises rated above a certain amount may be relied on to become consumers, and in the cases where it is possible to fix meters and a few lights free, a large number of small consumers may be secured.

As to the second point, the maximum demand upon the works would not appear likely to exceed, during the first two or three years, half the lamps connected, and this would gradually be reduced to about one-third of the total lamps connected.

The third point, the selection of the form of motive power, has, in many cases, given the author considerable trouble.

The selection of a site for the generating works is not difficult. In most small towns the disposal of refuse in conjunction with the supply of electricity may influence the selection of the motive power to be employed.

The form of motive power to be adopted must therefore depend upon local conditions, and it may be interesting to give some examples of the different kind of plants which may be adopted for a small town with a population of about 7,000.

The estimated lamps connected during the first two years are 3,000 of 8-c.p., and the estimated connections at the end of about the tenth year 14,000 8-c.p. The first instalment of plant would therefore require to be equal to about 60 kw., and might be divided into one 20-kw. and one 40-kw. plant; the latter sized unit of plant being continued as the station developed.

Confining now our attention to the generation only, the works would cost the following amounts:—

Oil.

Buildings and foundations	£250
Two engines, dynamos and switchboard	1,175
4-h.p. plant instead of accumulators	125
	£1,550

Town Gas.

Buildings and foundations	£250
Two engines, dynamos and switchboard	1,050
4-h.p. plant instead of accumulators	100
	£1,400

Producer Gas.

Buildings and foundations	£500
Two engines, dynamos, switchboard and producer	1,375
Accumulators	175
	£2,050

Steam.

Buildings and foundations	£750
Two engines, dynamos, switchboard and boilers	1,475
Accumulators	175
	£2,400

For the purpose of ascertaining the average cost of generation, it may be safely assumed that in the second year 30,000 units of electricity will be sold. The costs will therefore be approximately as follows for each form of motive power:—

Oil.

Oil, used as fuel	·5d. per unit.
Oil, waste and stores	·12d. ,,
Labour in the station	·40d. ,,
Repairs	·20d. ,,
Management, rents and rates	·37d. ,,
Depreciation, at 4 per cent.	·5d. ,,
Interest, at 4 per cent.	·5d. ,,
Total cost of generation per unit sold,	2·59d.

Town Gas.

At 2s. per 1,000 cb. ft., allowing 25 cb. ft. per unit.

Gas	6d. per unit.
Oil, waste and stores	·12d. ,,
Labour in the station	·40d. ,,
Repairs	·20d. ,,
Management, rents and rates	·37d. ,,
Depreciation, at 4 per cent.	·45d. ,,
Interest, at 4 per cent.	·45d. ,,
Total cost of generation per unit sold,	2·59d.

Producer Gas.

3 lbs. of coke per unit, at 16s. per ton.

Coke	·25d. per unit.
Oil, water and stores	·20d. ,,
Labour in station	·60d. ,,
Repairs	·24d. ,,
Management, rents and rates	·37d. ,,
Depreciation, at 4 per cent.	·65d. ,,
Interest, at 4 per cent.	·65d. ,,
Total cost of generation per unit sold,	2·96d.

Steam.

10 lbs. of slack per unit, at 8s. per ton.

Slack	·42d. per unit.
Oil, waste and stores	·20d. ,,
Labour in station	·60d. ,,
Repairs	·24d. ,,
Management, rents and rates	·37d. ,,
Depreciation, at 4 per cent.	·77d. ,,
Interest, at 4 per cent.	·77d. ,,
Total cost of generation per unit sold,	3·37d.

The above figures show the enormous importance of keeping down the capital expenditure. It may be urged that it is unnecessary to allow 4 per cent. for depreciation, and the same amount for interest, as a local authority can usually obtain 25 years for the repayment of its electric lighting loan, and this, allowing 3 per cent. for accumulating interest, would only equal 2⅔ per cent., and money can be borrowed at 3 to 3½ per cent., but it is much better to keep figures perfectly safe, and the larger the amount provided for depreciation, the sounder the undertaking will be.

In the oil, and town gas stations small plants are suggested for running the load from midnight until the following evening. These are so perfectly made that they may be safely left to run without any attention, and will be found to be much more economical and reliable than accumulators.

Where gas companies are in existence, it will be possible to obtain gas at a lower price than 2s. per 1,000 cb. ft., and in a few years, it might be found more economical to use producer gas.

If steam is adopted the locomotive form of boiler will save a large amount of capital, by dispensing with brick chimneys and flues, and it will be advisable to run non-condensing during the first few years.

System of Supply.

In most small places a two-wire 200 or 220-volt continuous-current system would be most suitable, but for long distances, alternating current at 200 volts with step-up and step-down transformers would be better.

The engineer must consider carefully the method of distribution. Most small places are scattered over a considerable area, and the length of mains per consumer will be much more than in large towns. The cost can be reduced if overhead wiring is adopted, and in a small town no argument of any importance can be advanced in opposition, while the arguments for overhead wiring are very strong—(1). It is much more economical. (2). More easy to keep in order. (3). Easy to substitute larger wiring when small wires are overloaded. (4). No disturbance of the pavement is necessary to connect consumers or find a fault. (5). The cost of connecting consumer is very materially reduced.

If we assume there are 120 consumers connected and three miles of mains, the sectional area being ·1 of a sq. in. (it would not be advisable to fix overhead such heavy cables at first), the cost would be as follows:—

Distributing System with Underground Cables.

3 miles of ·1 single cables, laid in wooden troughing	£1,290
20 cables connecting boxes	80
120 services boxes	240
120 services, including meters, fuses and fixing	540
	£2,150

Distributing System with Overhead Cables.

3 miles of ·1 conductors, fixed upon wooden poles	£770
120 services, including meters, fuses, and fixing	480
	£1,250

In regard to distribution with underground cables the cost per unit will be as follows:—

Labour	·12d.
Repairs	·16d.
Management, rents and rates	·16d.
Depreciation, at 4 per cent.	·69d.
Interest, at 4 per cent.	·69d.
	1·82d.

With overhead cables the cost per unit will be:—

Labour	·12d.
Repairs	·16d.
Management, rents and rates	·16d.
Depreciation, at 4 per cent.	·40d.
Interest, at 4 per cent.	·40d.
	1·24d.

If we add the cost of generation—2·59d., the total cost of production with the overhead cables becomes 3·83d. for the second year's working, and we may reasonably expect to see small undertakings working profitably and charging from 4d. to 4½d. per unit.

It will be noticed that the cost of services, meters, &c., is included in the above figures. The charge for meter rent usually covers the interest and depreciation upon the capital so expended, so that this item might be neglected, but the discount on cash accounts has been considered to balance meter rents.

The staff required to work the gas-driven plant would be:—

One engineer-in-charge (at £130), one assistant (at £68), one junior (at £52).

These would fix meters and services, and carry out overhead wiring, and the time expended upon such work would be charged to capital.

The lecturer concluded by a reference to the senseless attitude of local authorities who applied for prov. orders, and failed to carry them into effect; and who also opposed companies who wished to enter their districts.

THE LANCASHIRE AND YORKSHIRE RAILWAY ELECTRIFICATION.

Messrs. W. T. Glover & Co., Ltd., of Trafford Park, Manchester, have obtained from Messrs. Dick, Kerr & Co., Ltd., of London, the important contract for the supply, delivery and laying of the whole of the high-pressure mains to be used on the electrification of the Liverpool and Southport branch of the Lancashire and Yorkshire Railway.

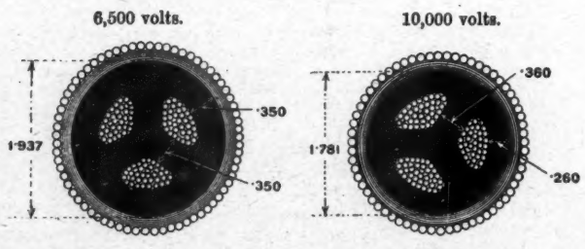
The cable is of Messrs. Glover's well-known armoured T.T. Distrine paper type as specially standardised by them for high-pressure work, and similar to the cable supplied in large quantities to the Manchester Corporation and others.

The working pressure between conductors is 10,000 volts, the centre point of the star being earthed; the pressure to earth is, therefore, only 5,780 volts. This earthing of the centre point has considerably reduced the cost of the cable, as a diminished thickness of insulation from earth is permissible under this condition.

The tests on this cable are very formidable indeed, especially when the comparatively small thicknesses are taken into consideration. They are:—

At Works.—30,000 volts alternating between cores (thickness, ·360 in.); 30,000 volts alternating between cores and earth (thickness only ·26 in.).

After Laying.—20,000 volts between cores, and between cores and earth, for one hour.



Manchester Cable. Lancashire & Yorkshire Cable.

An interesting comparison can be made between this cable and the one supplied to the Manchester Corporation. The latter cable was designed for a working pressure of 6,500 volts, centre of star unearthed, and when everybody was under the impression that the Board of Trade rule as to thickness of dielectric applied for all pressures. As will be noticed from the illustration, the thickness between the cores and between the cores and earth is ·35 in. The test pressure on these cables was 14,000 volts. The copper section in each cable is the same, ·15 sq. in.

There is much food for thought in the fact that Messrs. Glover have produced a cable to work at 10,000 volts, which is actually smaller in dimensions than the Manchester cable working at 6,500 volts, at the same time allowing more than twice the pressure tests on the cable.

Estimates for mains on high-pressure transmission schemes should be materially modified now that cables have been brought to such a pitch of excellence as the above performance denotes. The total quantity of cable to be laid is 32 miles approximately.

The solid system of laying has been adopted, the cables being laid in a wood trough, filled solid, with tile coverings, three cables running in each trough. The cables are to be run on the railway embankment the whole way.

The delivery of the cables has to be completed by June 30th, and the complete laying and jointing by July 31st. A large quantity of the cable has already been made and has successfully withstood the tests.

EARLY APPLICATIONS OF MAGNETO-ELECTRIC MACHINES.

In our issue of February 20th we reprinted an article from the *Society of Arts Journal* on "The Early Application of Magneto-Electric Machines for Electro-Metallurgical Purposes." In that journal for March 13th, the following letter, which had been received by Sir H. Trueman Wood, secretary of the Society of Arts, was published:—

"Sir H. Trueman Wood,

"Secretary of the Society of Arts,

"London.

"Dear Sir,—We have been consulted by Dr. Henry Wilde, F.R.S., with reference to an article in the *Journal of the Society of Arts* of January last, 'On the Early Application of Magneto-Electric Machines for Electro-Metallurgical Purposes,' and he has instructed us to write to you with regard to it.

"In our client's view, the article in question bears internal evidence of having been written by one who possesses much more knowledge of the subject than he has thought fit to communicate to his readers. The statements contained in the article are so far contrary to fact that, notwithstanding Dr. Wilde's unfortunate difference with the Council of your Society in the matter of the Award of the Albert Medal, we feel confident that he has only to place before you the true facts of the case to ensure your taking steps to rectify misstatements which are calculated to injure his reputation as the inventor of the separately excited dynamo-electric machine, and as the first to apply it to the electro-deposition of metals from their solutions.

"Dr. Wilde instructs us that notwithstanding the promise held out by Woolrich and others in the substitution of magneto-electric machines for voltaic batteries in the electro-deposition of metals, such machines soon fell into disuse, and the only one in actual operation, either in this country or abroad, at the time of the advent of Dr. Wilde's dynamos, 1866-1867, was at the works of Messrs. Elkington & Co., of Birmingham, where it was used to generate but a fraction of the power required for their productions, the greater part of their electro-depositing being carried on by means of voltaic batteries. This surviving magneto-machine was superseded by Dr. Wilde's dynamos in 1869.

"The further statement in the *Journal* with regard to the patent of Millward is misleading, and conveys to the reader the impression that Millward patented a machine for electro-metallurgical purposes, in which electro-magnets were separately excited by currents from a magneto-electric machine, an impression which is entirely contrary to the fact.

"W. Millward's patent, No. 13,536, 1851 (the specification of which we have seen), consisted of two improved forms of magneto-electric machines with permanent magnets, the currents from which, the inventor states, are to be used to excite an electro-magnet, for the purpose of magnetising permanent magnets of steel or cast-iron.

"No suggestion whatever is made in Millward's specification of the generation of electric currents from the electro-magnet so excited, nor is the application of his improved magneto-electric machines to electro-metallurgical purposes so much as mentioned.

"You will perceive that the writer of the article in question, without mentioning our client's name, in effect alleges that his invention of the separately excited dynamo was anticipated by Millward's patent. When we say that W. Millward himself was one of our client's earlier licensees, under an agreement which the predecessors of our firm prepared, for the application of our client's machines to electro-metallurgical purposes, and that Millward made a substantial annual payment in the form of royalty for a period of 14 years, notwithstanding that he might have terminated the license so granted at the end of any one year, you will see how inaccurate the article in the *Journal* is.

"Dr. Wilde tells us further, that during the whole period of his business relations with W. Millward, the latter never referred to his patent of 1851 for electro-magnetic apparatus, although he had frequent opportunities of so doing.

"W. Millward's name, as also that of his brother Arthur Millward of Sheffield, will be found in the list of Dr. Wilde's licensees sent to you on June 18th, 1900, at the time when the terms of the award to him of the Albert Medal of the Society of Arts were under discussion.

"Dr. Wilde instructs us to say that he trusts that a consideration of the inaccuracies to which we have drawn your attention above in the matter of the history of the dynamo-electric machine may lead to a better understanding between himself and the Society, for which, notwithstanding his past differences with its former Council, he has always entertained, and still entertains, the highest regard.

"You will no doubt now wish to take steps to rectify, so far as may be possible, the mischief caused by the article to which our client complains. As indicating in some degree the manner in which the mischief spreads, we may say that the article was reprinted in the Electrical Review of the 20th ulto.

"We shall be glad to hear from you at your early convenience.

"Yours truly,

"Slater, Heelis, Williamson & Co.

"Manchester, *March 10th*, 1903."

REVIEWS.

Specification for Architects, Surveyors and Engineers when Specifying, and for all interested in Building. Published annually by the proprietors of the *Builders' Journal* and *Architectural Record*, 9, East Harding Street, E.C. Price 5s. net.

This, the sixth issue of a useful annual, is a compilation of short illustrated articles upon the design and construction of buildings adapted for uses differing as widely as a church and a pigsty. Since each article is accompanied by plans of actual buildings, and is contributed by an expert in that particular line, no one can study the book without becoming interested, as well as gaining a great deal of useful information.

One section deals with architectural professional etiquette, and one cannot help regretting that the canons of conduct were as stringent in our own profession.

The portion devoted to electrical matters is hardly as complete as might be wished. No notice is taken of the model general conditions for electrical contracts recently prepared by the Institution of Electrical Engineers. The fire office rules issued by the London and Liverpool and Globe Insurance Companies are reprinted in full, together with a proposed model wiring specification, and some general remarks upon lamps, lightning conductors, lifts and telephones. In future issues, we think more attention might profitably be directed to the varied applications of the electric motor.

Each trade connected with the complete erection and equipment of a modern building receives notice, and as examples of the phrasing of specifications are included in practically every instance, the book is valuable as a reference to both consulting and contracting engineers.

Lathes, Screw Machines, Boring and Turning Mills. By Thos. R. Shaw. Manchester: Scientific Publishing Co. 1903.

Very little has been written in this country on machine tools and the machine tool trade: after setting out well in the days of Whitworth and Roberts, we never seemed to get very far out of the groove. Thus, though accurate and good tools emanated from this country, our later practice made no advance, and in many respects we found ourselves being out-stripped by the Americans. But the inroads of American tools have not been maintained as once appeared likely. Our own makers have picked up their feet, and of late have moved pretty nimbly. Americans also have learned some things here; the best American machines have been improved, and their prices are not now so competitive as they were, for well-made tools everywhere cost money. The better American products will continue to come in; the inferior products have been found out. Nor has German competition turned out to be of particular moment. Many of the German tools were veritable Chinese copies of American machines, but Germany cannot compete in price. If a good solid tool is wanted the home makers can take the order. For lighter, cheaper goods the American will easily give the German the go-by, and meanwhile the English toolmaker is getting better re-established every day.

Such a book as this would hardly have sold a few years ago. It is a well-illustrated, well-dimensioned treatise on its particular subject, and should appeal to shopmen who are keenly interested in machine details such as the flat or vee form of lathe bed, and the apron arrangement of the carriage.

As the author says, few American lathes had compound rests until lately, but they were provided with a special taper-turning attachment at the back of the bed, which is not looked on with much favour here, and is likely to disappear from such American lathes as have adopted the English compound rest.

The vertical boring mill, which was first brought out in this country, received its real development in America, but it is now made in this country by Richards, Hetheringtons, and others. As in most other branches, the English toolmakers are by no means asleep to-day in the making of these mills, and other special tools.

In automatic screw machines, for example, we have the Wolseley Co., of Birmingham, and Herberts, of Coventry, fully to the front with machines of substantial design. Half the trouble with foreign machine tools is the lack of substantiality.

We are glad to see that the author condemns the lack of general system in regard to the tapers of holes in spindles. The nuisance of different tapers is very great, necessitating expensive and inconvenient double socket adjustment pieces. Even toolmakers themselves never seem to know what a standard taper is. They cannot always say what are the ruling dimensions of the Morse standard, while some of the German toolmakers have committed the folly of starting new tapers of their own which have not even the merit of regular taper angles.

The illustrations in this book are excellent, but too often they appear sideways on the page, which renders them inconvenient. We congratulate the author on his work, which must have involved an immensity of labour.

Factory Accounts. By Emile Garcke and J. M. Fells. London: Crosby Lockwood & Co. 7s. 6d.

This is the fifth edition of a work which, we believe, was one of the first to be published on the general subject of factory organisation and accounts. It is a subject which, until the last few years, received very little attention from engineering firms in general, and even now is not regarded favourably by many heads of firms who consider that any attempt at system increases their clerical expenses without giving any corresponding advantage.

The purpose which the authors have set before them has been to point out the advantages which accrue from a properly organised system, and to show how such a system may be established and maintained.

Put briefly, the method which the authors lay down consists in arranging a works in three parts, a warehouse (for finished stock), a stores, and a factory. All orders to the factory, whether for single complete machines, or for quantities of parts to be assembled subsequently to form complete machines, are given out from the warehouse while customers' orders are received into, and dealt with entirely by, the warehouse, so avoiding the confusion and mistakes which occur when customers' orders, and stock orders, are jumbled together in the same books. The stores are used to contain only materials for purposes of manufacture, and not finished stock in addition; a further source of waste and mistakes being thus eliminated.

The book-keeping system is made to include the cost accounts as well as the accounts which are purely commercial, and the whole system is made to converge upon and be governed by one central book, the commercial ledger.

Their costing accounts are so arranged as to give costs in detail, and not merely in gross, so enabling unprofitable work to be weeded out, and as, instead of being mere records, they agree with the commercial books; their accuracy is ensured, and a large amount of waste is avoided.

The authors admit the necessity of minimising clerical labour, but they further state that the maintenance of a perfect organisation may enable economies to be practised in comparison with which the whole cost of the office staff is insignificant.

In Chapter II., on labour, the authors commence with the workman's checks and daily time tickets, and trace the labour record right through to the labour allocation book, concluding with a diagram showing the correlation of the various books.

In this chapter we note that the authors give a good deal of space to a description of the old time-check system, which is still in use by a good many backward firms, and they mention, briefly, two forms of recording machines which print the men's times on slips from which they have to be posted into the time book (specimens 1, 2 and 3). They

do not, however, make any mention of the more recent machines in which the men's times are printed on a weekly ticket which can itself be totalled up and posted direct to the wages book (specimen No. 14), the time book, with its tedious clerical work, being done away with.

It is, perhaps, a small matter, but we have ourselves found that, instead of comparing the time book and allocation book, as described by the authors, once a week, it is better to compare the time record sheet daily with the time book, so that errors are discovered and corrected while they are fresh in the memory, and erasures and alterations in the books are avoided.

Chapter III. deals with the purchase of materials for manufacture, their receipt into the stores and the process of passing them out to the various orders in hand.

There is one point on which we should have liked some information from the authors, and that is, the best method of dealing with cases in which a small percentage of the material on an order consists of trivial quantities of a large number of materials. Thus in a dynamo about 95 per cent. of the material may be contained in 20 entries, while the remaining 5 per cent. may consist of a large number of little odds and ends requiring twice or three times as many entries to record them, so entailing an amount of clerical work, the cost of which is out of all proportion to the value of the information obtained.

Owing to breakage of bulk when in the stores, and to variation of prices from time to time, it is a little difficult to make the materials side of the prime costs agree exactly with the commercial books. The authors do this by keeping each account in the stores ledger (specimen No. 26) in money as well as in quantities.

Chapter IV. deals with the books required for keeping the prime costs, and shows how they are made to tally with the commercial ledger.

The remaining three chapters treat of stock, fixed capital, and various subsidiary matters.

In Appendix A, a reprint is given of a paper by Mr. Oberlin Smith on the nomenclature of machine details.

The system of symbolic nomenclature has considerable advantages, but can only be adopted successfully in cases where a large number of machines are made to one design, which remains unaltered over fairly lengthy periods.

In a new or rapidly progressing industry in which designs are altered and improved almost daily, any attempt at such nomenclature results in hopeless confusion.

Appendix B, dealing with the Income Tax Acts, is one which should be carefully studied by those who are designing new sets of factory accounts, as it will guide them to a correct arrangement of their commercial ledger, so as to show the profits in the form required by the Acts.

Appendices C, D and E, dealing with rating of machinery, fire insurance, &c., are also worthy of the attention of those interested in factory matters.

Coal-Cutting by Machinery in America. By A. S. E. Ackermann, A.M.I.C.E., &c. London: the *Colliery Guardian* Co., Ltd. Price 12s. net.

This work, which is well got up and printed in easily read type, forms No. 16 of the *Colliery Guardian* series of handbooks. It is intended to form a companion volume to "Coal-Cutting by Machinery in the United Kingdom," by S. F. Walker, which was published early in 1902.

The volume now under consideration is a collection of facts, statistics and descriptions relating to American coal mining practice rather than a text book in the ordinary sense of the word. The information contained in it is both lucid and up-to-date, and much of it has no doubt been difficult to collect.

The description of American coal mining machinery is restricted to those machines only which have attained measurable success in practice, and this is a noteworthy feature in present-day scientific literature.

The first five pages immediately preceding Chapter I. contain statistics relative to the area, position and nature of the products of the various American coal fields. The introductory Chapter I. gives further statistical figures as to the working costs and annual outputs in Great Britain and America, proportion of output mined by manual labour and machinery in the two countries, and several tables of figures of a most instructive nature. These statistics, while extremely interesting, show in a highly marked degree the beneficial results accruing from the introduction of machinery on a large scale.

Chapter II. deals with descriptions of percussion machines and the local conditions under which each type is worked in many American mines.

Chapters III. and IV. deal with the various types of chain-cutter Breast machines and Longwall chain machines respectively, while Chapter V. contains the costs of production by hand and by machinery, together with the selling prices of the coal, and the percentages of mining casualties in this country and America. This useful little volume, which is a welcome addition to mining literature, concludes with Chapter VI. on coal-handling appliances. Beyond doubt the contents of the book cannot but open the eyes of any reader to the rapid development of coal mining in America, as compared with that in this country, and also to the extensive use which is there made of electric, as well as other kinds of coal-mining machinery.

SAFETY DEVICES FOR TRAMWAY TROLLEY WIRES.

By DONALD SMEATON MUNRO, A.I.E.E.

(*Concluded from page* 473.)

Fig. 7 is the same, except that the two coils A and B are shown wound on one core, the guard wire is divided at the centre, and the resistances R and R′ are at the two

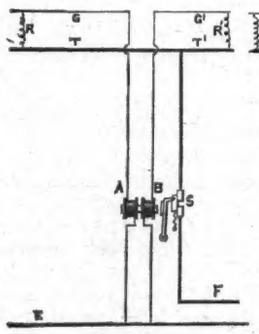


Fig 7.

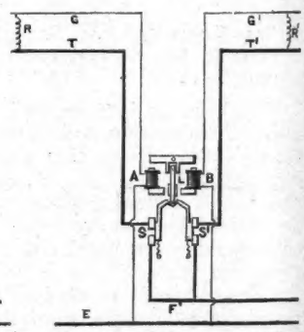


Fig. 8.

extreme ends of T. This arrangement is applicable when a trolley section is fed at its centre, or when two or more lines in parallel or radiating are fed at one point.

Figs. 8, 9, and 10 are much the same as the foregoing as regards their connection, and represent an effort to limit the portions of line disconnected, and to reduce the number of resistances through which a very small current is always running to possible waste. In these each feeder supplies, at their contiguous ends, at least two sections of overhead line. The principle in fig. 9 resembles that of fig. 7, except that one "near" coil, A, between feeder and earth is used to balance two sets of coils, B and B′, supplied from far ends of trolley wires *viâ* their guard wires as before.

In figs. 8 and 10 only two coils again are used. The connections are like those already described, but the coils are shown as balanced in their pull on the two ends or cores of a pivoted armature, and not therefore wound to otherwise oppose each other. It will be noticed that, in this arrangement, if, say, T′ breaks, only coil A pulls and *vice versâ*, while if T′ makes electric contact with G′, as by a fallen telephone wire, then coil B is the stronger. Thus, with the same make of switch, S, as before, in one case or the other a fault on, say, the right-hand section would cut off only the left-hand or perfect section from its feeder. To obviate this the armature is constructed in two parts, one light enough

to be pulled by the comparatively weak normal pull of A or B alone, when the current in its neighbour ceases, while the other and heavier part of the armature is pulled only by the powerful current due to contact between the guard and trolley wires. This powerful current, of course, pulls both armature parts. It was thus needful to make a mechanical arrangement such that when any given end of the light part of armature alone

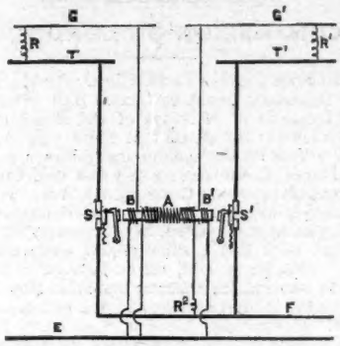


Fig. 9.

rose, the proper switch (say S) was set off, and when the opposite end of both parts of armature rose, the same switch (S) was actuated. Figs. 8 and 10 show two methods of accomplishing this.

In fig. 8 the arms of S carrying the notches in which the double detent engages are flexible, but outwards only. This permits the detent arm of the light vertical armature to move sufficiently to disengage one S without freeing the other. When both armatures move together, the heavy, strongly-pulled, horizontal armature overpowers the light armature with its detent and pushes it in the proper direction.

In fig. 10 the detent arms are shown pivoted to the light armature. If T' break, coil A pulls up its end of the light armature only; its detent arm, therefore, is lifted at the rear end only, and so remains engaged with switch S. But the other end of the light armature goes down; consequently it draws

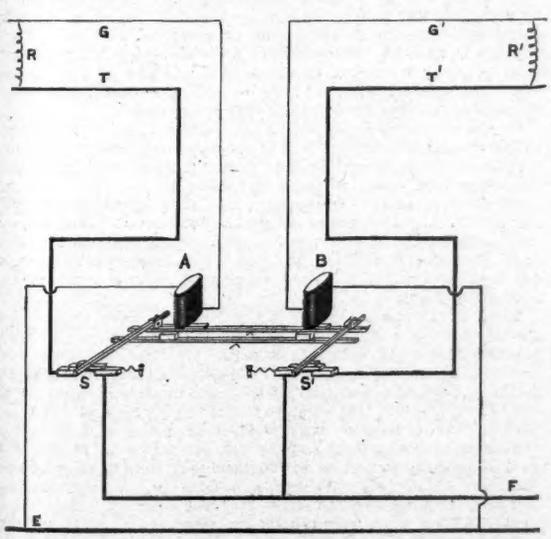


Fig. 10.

down the rear end of S' detent arm; this arm turns on the stationary heavy armature as a fulcrum, lifts its front end, and releases S' as desired. But when T' is put in contact with G', a strong current flows in B, and the S' ends of both armatures are raised, and S' again is opened.

The reader is reminded that these drawings are diagrammatic to illustrate the principle of action clearly. The mechanical details and proportions would, of course, in practice, differ from what is here drawn.

All these magnets and armatures are capable of the usual variations; thus the cores may be fixed or carried by the armatures, or the armatures may be fixed and the coils movable, the mechanical details being made to suit. Also the magnet forms illustrated on the various devices may be interchanged wherever mutually applicable.

A safety device is illustrated in the catalogue of the General Electric Co., Ltd., London, dated August 2nd, 1901. In this device each feeder branch to trolley wire is also connected, through the high resistance coil of the electro-magnet of an automatic switch, to a neighbouring point of the otherwise insulated guard wire. The idea is that a fallen telephone wire will earth the guard wire, and so cause a current to flow in the coil referred to, and free the switch. This method is open to the following, and other objections: (1) The guard wire is normally at the same potential as the feeder. This increases leakage, and might give a dangerous shock to anyone touching the guard or an unearthed telephone wire lying on it: the high resistance of the coil would not, with the resistance of a man's body in circuit, reduce the pressure much. (2) A fallen telephone wire might not be earthed and, lying across the guard, might dangle down. Thus the device would actually increase the danger. (3) If the guard wire or the trolley wire broke without making good earth, the apparatus would not act. This is evidently recognised so far as the trolley wire is concerned, for overhead circuit breakers on this wire are also recommended.

In the consular report regarding the trade of Bohemia for the year 1901, issued by the British Foreign Office, July 1902, there is a description of a device by Krizik and Hinnen, apparently patented by them in Bohemia on April 28th, 1901.

In this the feeder current passes by way of an auto-switch coil to the trolley line. The far end of the trolley line is connected through a resistance to the guard wire, so that a small current returns by the guard wire and round an electro-magnet coil, which *holds in* the detent arm of the auto-switch. If wires fall on the guard wire, unless they make very good earth, no effect is produced on the switches. If the guard and trolley wires are connected, as by a fallen wire which may hang down within reach of the public, the switch holds on more firmly than ever, unless the current exceed the ordinary overload, and melt a fuse in the feeder circuit. But if the guard or trolley wires break, the switch is released, the trolley wire is disconnected from the feeder and put to earth. The protection thus afforded is evidently incomplete. It has the further important defect that every auto-switch in the system would open when current failed, or was cut off from the generating station, and would have to be reset by hand.

These criticisms are, of course, to be taken merely as expressions of the opinion of the writer.

THE "1903" REVISED RULES OF THE I.E.E.

The new, or, to speak more correctly, the revised "General Rules for Wiring for the Utilisation of Electrical Energy," recommended by the Institution of Electrical Engineers, form a most important document, comprising some 19 pages, together with index and wiring table, and have been compiled by a committee of experts representative of the several branches of the electrical trade and profession. In reviewing such a work, therefore, it is almost necessary to assume that the *raison d'être* for every rule—it may almost be said for every word—has been fully discussed from all sides, and submitted to the fiercest light of criticism; the best theory and practice have been joined to place on record statements and opinions which may be considered thoroughly up to date, and to weed out unnecessary and frivolous restrictions due to misconceptions of the past or to personal fads. It remains, then, for the reviewer rather to discuss what changes have taken place and the effect they are likely to have on the future of electrical wiring, than to seek for errors, if such there be; the latter will in due course be reported to the Standing Committee by those for whose use the rules have been framed.

The rules have been arranged under certain broad headings as follows :—General arrangement, Conductors—conductivity and size, Conductors—insulation, Conductors—joints, Buried conductors in buildings, Conductors—wood casing for, Conductors—precautions at points of connection, switches, fuses, Connectors : wall and floor plugs, &c., Ceiling roses, Switch and distribution boards, Fittings for supporting lamps, Lampholders, Arc lamps, Incandescent lamps, Dynamos and motors, Resistances, Choking coils, Accumulators and other batteries, Transformers, Electric cooking appliances, Radiators and heaters, and Testing. These headings, it will be seen, practically cover the whole of the devices used in the supply of electrical energy ; and we shall follow this order in discussing the rules.

A short introduction announces the fact that the rules are framed to secure satisfactory results with a supply not exceeding 500 volts if continuous, or 250 volts if alternating, but it will be noticed throughout that the framers of the rules do not assume the general use of a greater pressure than 250 volts, at any rate, between outers and neutral for continuous current supply. This is satisfactory, as it is doubtful whether many of the present fittings sold for 250 volts would be suitable for double the pressure, even with the precautions suggested, without modifying their construction. In the case of alternating pressures over 250 volts, the Committee would no doubt be willing to make special suggestions, although nothing is said on this point.

General Arrangement.—In this section, which is the most important one, we notice that Rule 3 fixes 3 amperes as the maximum for high-voltage sub-circuits, whereas the 1897 rules only mentioned 5 amperes in a general sense. The former current has, we believe, been generally adopted as standard. Rule 4 makes the concession of bunching, *if without joints*, of small wires in casing, whereas this was previously forbidden ; but, no doubt, the stringent requirements regarding fusing make this permissible. Conductors under *metallic* protection must be bunched so that the sum of the currents is zero when the supply is alternating ; but presumably the Committee had in view only the use of iron or steel conduits ; where Muntz metal or other alloys are employed (as they occasionally have been), this rule would, perhaps, not be enforced.

Rule 5 is a most important one, in view of the frequent practice of earthing one of the main conductors of supply ; the possibility of getting a shock or of a leak being established on an installation is great if a switch is allowed to be broken on the earthed wire only. Wiring contractors should be carefully watched in this connection, so that point switches are not put on the wrong wire. It is true that the old rules make provision against the above-mentioned possibilities, but no such concise statement as in Rule 5 is made. Rule 6 places on record that a fuse must not be inserted in the neutral conductor—a very necessary prohibition against the three-pole switch and fuse—and Rules 7 and 8 further amplify and modify this point as regards sub-circuits.

Rule 9 is interesting as making the use of a concentric system with bare outer permissive. It remains to be seen whether the supply authorities will in practice lend their consent to a system so long barred, but which would tend to considerably reduce the general cost of wiring ; or does the rule after all only apply to those installations with private plants whose owners may have to deal with the insurance offices ?

Rule 10 recognises for the first time the three-phase system, and Rule 11 is framed for those installations where circuits from both sides of a 400—500-volt three-wire system are taken into one building. Except at the distributing switchboard, it is not very apparent how the two outers could be so disposed as to enable a person to touch both simultaneously. However that may be, the possibility is not alluring, and the rule may be useful to check the vagaries of wiremen.

Rule 12 is instructive, with the accident at Fulham Baths in our memory. It would appear that to guard against such fatalities the rule might be extended to include conductors carrying current at *any* pressure ; at any rate, the rule makes it clear that tubing with butt joints must not be used for pressures over 250 volts. Rule 13 only states what has been observed now for some years in good wiring work, but it would be interesting to know what the Committee recommend in order to render a base block impervious to moisture. It appears to us that it is not so much this qualification which is required as some means to prevent surface condensation on the edge of such base blocks, and how can this be prevented ?

(To be continued.)

ROYAL COMMISSION ON LONDON TRAFFIC

Sir David Balfour presided on 20th inst. over the second sitting of the above Commission, held at Caxton Hall, Westminster, when Col. Yorke, Inspector of Railways of the Board of Trade, continued his evidence. He stated that there were uniform fares in Paris and New York on the underground railways, and he favoured the universal fare. In Buda-Pesth they had tramway subways, and these were easily reached. Consequently, there was no need of lifts, and the risk attaching to lifts was eliminated. In Boston, where the streets were congested, the tramways left the surface of the street, and went into a subway, and afterwards came to the street again. That, he thought, might be done in certain parts of London. The whole of the tramway system in New York was to be constructed on the conduit system, and the cables would be placed underground. He thought, however, that many London streets prohibited the construction of tramways, whether constructed on the overhead or conduit system. For surface tramways, he thought the lines should be in the middle of the street. The underground railway of Paris was entirely independent of the other traffic, and there was no physical connection. The rolling stock of the other French railways could not traverse the underground railway, but in New York he believed an attempt was being made to connect the steam railways with the subways. In London there were certain rights claimed by frontagers, and there were cellars extending under the streets which undoubtedly would involve the authority constructing subways in great expense, and he imagined that the network of drains, pipes, &c., was more complicated in London than in Paris.

By Sir Francis Hopwood : In Boston the system of traction adopted was the overhead system both on the surface and in the subways, and the conductor was on the roof of the subway. He considered it would be exceedingly useful if the diameters of the subways were made large enough to accommodate surface railways, and he felt that the tribunal which might be entrusted with the authorisation of schemes for London traffic should be invested with powers to order the acquisition of land for road widenings, and the local authority might in some cases be required to contribute to the cost.

Replying to Lord Ribblesdale, Witness said that in the Tube Bills there was a vibration clause inserted for the security of property owners ; and he thought a good deal had been done by Parliament for the protection of property owners who might possibly be affected. He took it that Parliament would never part with its power to confirm or revise the decisions of the tribunal appointed to deal with the question.. New thoroughfares, wider streets and subways would be the only real remedy.

In answer to Sir J. Wolfe Barry, Witness said that in recommending shallow tramways he did not anticipate having continuous platforms. There should be fixed stopping-places, with access from the street level down to these particular places. He could not view the introduction of tramways into the City of London with favour. When he spoke last week as to the advisability of a tramway along the Embankment, he contemplated carrying the tramways over Westminster Bridge. He had never contemplated carrying the tramways under the river to connect up the northern and southern systems.

Mr. J. M. Dodds, a member of the Light Railway Commission, described the procedure before that body. Directly the Commission submitted an order for confirmation by the Board of Trade they had nothing more to do with it. The Commission were supposed to facilitate proposals, and they took that to mean that when people wanted information they came to the office and they placed before them all the information they could. There was no definition in the Act as to what a light railway was, and this gave them a great deal of difficulty at first as to whether they were to supersede the Tramway Act of 1870. There was nothing in the Light Railway Act to make them exclude street tramway schemes. They had to deal with lines which were usually described as tramways, and they refused to deal with certain lines which appeared to be exclusively in the form of tramways—that was a line in an urban district which might just as easily be promoted under the Tramways Act. He thought they might have dealt with such lines if they had chosen to. The general object of the Light Railways Act was to delegate to the Commissioners certain powers which were ordinarily exercised by Parliament under the procedure followed in the case of private Bills. In many details the Commission followed the procedure which was followed in the case of private Bills, but not strictly. They held their inquiries locally, and they found they got through the business quickly, because people came away from London or other centres of business and were willing for the sittings to commence early, and no time be lost, so that they could get away. The experience gained by the Commission led to expedition, because explanations as to technical matters which might be required before a tribunal not conversant with the subject could be done away with. They did not find many of their decisions reversed by the Board of Trade, but they were often modified, and personally he felt that it was a benefit to have an appeal to an independent tribunal. They

had had 400 applications before them in seven years, and there was no doubt that if many of these had been required to adopt the expensive procedure of promoting a private Bill they would not have been applied for.

Replying to Earl Cawdor, Witness said they had had applications from the Middlesex County Council, the London County Council, and the London United Tramways Co., and all these proposals, except those of the London County Council, had been approved. Those were tramway proposals which could not have been proceeded with under the Tramways Act because they contained proposals to acquire land. Under the Light Railways Act, the frontagers had no right to oppose, and he thought that any persons having right of opposition under the Tramways Act should have the same rights under the Light Railways Act.

Mr. J. J. Dodds, Assistant Under Secretary for Scotland, gave evidence as to the procedure for private legislation in the case of tramways and light railways in Scotland.

The Commission then adjourned.

PHYSICAL SOCIETY.

At a meeting held February 27th, Dr. R. T. Glazebrook, F.R.S., President, in the chair, a paper by Prof. Fleming and Mr. Clinton "On the Measurement of Small Capacities and Inductances" was read by Prof. Fleming. For the measurement of small capacities, when the dielectric is air or some other substance not possessing absorption, the rapid charge and discharge of a condenser through a galvanometer has been extensively employed. The authors have designed a rotating commutator which renders the measurement of small capacities as easy as that of resistance. The appliance is described in the paper. For use with the instrument a moving coil differential galvanometer has been designed. The magnetic field at either of the coils can be varied by means of a piece of soft iron which can be moved about in the field. The authors have made a number of experiments upon the capacity of aerial wires, and have investigated the laws governing the capacity of such wires when grouped together in certain ways, and verified experimentally, as far as possible, the formulæ for the capacity of insulated wires in various positions in regard to the earth. In all cases the total measured capacity of n wires is less than n times the capacity of one wire. For the measurement of small inductances the authors have constructed an instrument, similar to the secohmmeter of Ayrton and Perry, upon the same lines as their rotating commutator. By making the apparatus substantial and eliminating all insulating material, except air, from the surface of the rotating drums, and abolishing all flimsy spring contacts, they have produced an apparatus which is much more satisfactory to work with than the ordinary secohmmeter.

Prof. Ayrton said that the secohmmeter used in his laboratory was like the one exhibited. The fact that air was superior to other substances as the insulating material at the surface of a rotating commutator had been recognised by Prof. Perry and himself in a patent taken out many years ago. He asked in what respect Anderson's method of measuring a self-induction was superior to the method of comparing it directly with a standard variable self-induction. Referring to the galvanometer used in the experiments, Prof. Ayrton pointed out that the device of shunting the magnetic flux through a piece of soft iron had been used before. Some years ago a series of observations were conducted in his laboratory to determine the errors which might enter into experiments carried out with a rotating commutator, and he remarked that, in order to avoid contact differences of potential, it was essential that the commutator and the brushes should be made of the same material.

Referring to the measurement of small capacities, Prof. S. P. Thompson briefly described a method which he had published similar to Carey Foster's method of comparing two nearly equal resistances. All that is required for accuracy is a known standard capacity and a calibrated sliding condenser.

Mr. A. Campbell exhibited the commutator used for condenser tests at the National Physical Laboratory. In this commutator the ebonite insulation does not fill the spaces between the segments, and is never touched by the brushes, thus giving satisfactory insulation. By its aid many measurements have been made of the B.A. air-condensers, the capacity of each of these being about 0·02 mfd. In the earlier experiments an ordinary moving-magnet galvanometer was used, but it was discovered that if the magnet at its zero position was not exactly parallel to the planes of the coils, its deflection was partly due to the mean current and partly to the square-root mean-square current. A moving coil galvanometer was found to be quite free from such effects, and this type had been used in nearly all the tests. The differential galvanometer described by the authors appeared admirable, a great advantage being that the mutual inductance from coil to coil would be very small.

Mr. Jacob pointed out that if a differential moving-coil galvanometer was correctly balanced for one point of the scale, it did not follow that it would remain balanced at any other point.

Mr. J. T. Morris drew attention to the fact that the capacity of a condenser might depend upon the form of the wave of potential difference which charged it.

Mr. R. Appleyard said that the capacity of a condenser with mica dielectric determined from a single charge and discharge was practically the same as that obtained from several charges and discharges per second. This was not the case with rubber. He asked if the authors had observed differences in capacity depending upon the point of attachment of the leading wire.

Mr. W. C. Clinton, in reply, said they had used Anderson's method because they found it more convenient than any other. It required no arbitrary standard of inductance or determination of speed, the only things required being resistance-boxes and a known capacity. They had obtained different capacities for wires by varying the point of attachment of the lead, the maximum variation amounting to about 5 per cent. of the total capacity.

A paper "On the Thickness of the Liquid Film formed by Condensation at the Surface of a Solid" was read by Dr. G. J. Parks.

At the meeting held March 13th Dr. R. T. Glazebrook again presided. A paper by Dr. Farr, "On the Interpretation of Milne Seismograms," was read by Dr. Chree.

"A Potentiometer for Thermo-couple Measurements" was exhibited and described by Dr. Lehfeldt. To make a satisfactory potentiometer for thermo-electric work, it is essential that it shall not introduce a high resistance in the circuit of the couple and galvanometer. Most of the potentiometers on the market fail in this respect. From the positive terminal of an accumulator a current flows to a switch, by means of which it can be sent through 100, 1,000 or 10,000 ohms in order to get three grades of sensitiveness; it then passes through 20 coils of 0·1 ohm each, a slide-wire of a little more than 0·1 ohm, and through an adjustable resistance back to the accumulator. The fixed resistance of 100, 1,000 or 10,000 ohms is shunted by a cadmium cell and a galvanometer, and the adjustable resistance is varied until balance is obtained. The thermo-couple and the galvanometer are then put across any number of the tenth-ohm coils and any fraction of the slide-wire. Great care has been taken to avoid accidental thermo E.M.F.'s, which are the chief trouble in using thermo-couples. The only metals used in the measuring circuit are copper and manganin. The position of the sliding contact upon the bridge wire can be read by means of a vernier to $\frac{1}{10}$ mm., corresponding to $\frac{1}{1000}$ of the unit employed, which may be 1,000, 100, or 10 microvolts according to the fixed resistance used. The paper concludes with a description of the calibration of the various parts of the instrument and of the precautions to be taken when using it.

Dr. J. A. Harker exhibited and described "A Direct-reading Potentiometer for Thermo-electric Work." The instrument represents a form which has been designed and made in the National Physical Laboratory, and it is similar in many respects to the one described in the previous paper. The main current from an accumulator flows through a series of resistances, any one of which can be short-circuited at will, and then through the balancing coils. By means of the adjustable resistance the standard cell employed can easily be made to cut off from the main circuit a resistance numerically equal to 100 times its E.M.F., and therefore 1 ohm on the potentiometer circuit is equal to $\frac{1}{100}$ volt always. The balancing coils consist of 20 coils of 0·1 ohm each in series with 11 coils of 0·01 ohm each. Any two of these latter coils can be put in parallel with a slide-wire of 0·02 ohm resistance. The slide-wire is provided with a scale of 200 divisions, and as the fall along the wire is 100 microvolts, 0·1 microvolt can easily be estimated. The slide-wire acts as a vernier to the small coils. Copper and manganin are the only metals used, and the connections are made by means of mercury cups.

Mr. W. A. Price referred to the large number of coils requiring calibration in the instruments exhibited. In working with sliding contacts in a dusty workshop, it is an advantage to immerse the bridge in paraffin oil. The contacts are then always good, instead of uncertain and intermittent. He had also found that if two silver surface plates were screwed together, the contact resistance was less when they were immersed in paraffin than when they were in air.

Mr. Whipple said that he also had found that contact-resistances in oil were less than in air.

Dr. Watson said the effect of the oil seemed to depend upon the shape of the surfaces in contact, or it ought to be an advantage to grease the plugs of resistance boxes. After what Mr. Price had said, it would be interesting to work with a resistance box immersed in oil.

Prof. Everett suggested that the paraffin drives off the film of air from the metals.

A paper on "The Measurement of Small Resistances" was read by Mr. A. Campbell. The object of this paper was to give a brief account of a number of measurements of a set of low resistance standards belonging to the National Physical Laboratory. The tests were made partly with a view to comparing various methods of measurement. The resistances were of manganin, and their nominal values were apparently 0·1, 0·01, 0·001 international ohms. The following methods were employed:—(1) Shunt potentiometer; (2) Kelvin bridge; (3) Two-step bridge; (4) Differential galvanometer; (5) Matthiessen's and Hockin's method. The last method was found to be much less accurate than the other four. The results obtained from the other methods were tabulated in the paper, and showed very satisfactory agreement.

Dr. R. A. Lehfeldt read a paper on "A Resistance Comparator." Objecting to sliding-contacts on account of the thermo-electric effects they tend to introduce, and irregularities slide-wires show when a good deal used, the author has substituted for the slide-wire two coils of 99 ohms each connected by 20 coils of 0·1 ohm each. The latter are arranged circularly, so that a switch connected to the galvanometer may be set on any one of the intervening studs. The galvanometer deflections are taken for the two positions nearest balance and interpolation to $\frac{1}{100}$ calculated. In this way an accuracy of one part in 100,000 is attainable. The author thinks there is a gain of accuracy as well as of convenience in using the interpolation method.

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

5,400. "Improvements in or relating to electrical ignition apparatus." J. J Horne. March 9th.

5,429. "The Inomel instantaneous electrical photographic flash light." C. A. Copinger, H. W. Thomas and F. McElroy. March 9th.

5,441. "An improved form of electric light." Sir William Ramsay. March 9th.

5,448. "Electrolytic zincing process." I. Szirmay and L. von Kollerich. March 9th. (Complete.)

5,459. "Improvements in holders and connections for electric incandescent lamps." J. R. Quain. March 9th.

5,468. "Method of sending and receiving electric currents." W. Hepworth. March 9th.

5,480. "Improvements in or relating to electric gas lighters." A. J. Boult (Electric Contact Co., U.S.) March 9th.

5,493. "Improvements in apparatus for measuring electric resistances." S. Evershed and Evershed & Vignoles, Ltd. March 9th.

5,494. "Improvements in electric motors and regulating devices for railway trains or vehicles actuated by electrical energy." J. S. Raworth. March 9th.

5,503. "Improvements in wireless telegraphy." H. Cunynghame. March 10th.

5,520. "Improvements in dynamo-electric machines and motors." T. A. B. Carver and Textile Appliances, Ltd. March 10th.

5,545. "Improvements in or relating to electric lamps." W. Fairburn-Hart. (The General Electric Co., U.S.) March 10th. (Complete.)

5,561. "Improvements in or relating to dynamo-electric machines." F. Porsche. March 10th.

5,572. "Improvements in electric arc lamps." J. J. Rathbone and E. R. Smith. March 10th.

5,574. "Improvements in or relating to electrodes for use with high frequency currents and other electrical appliances." H. W. Cox and C. W. Maunsell. March 10th.

5,587. "Improvements for mouthpieces of transmitters and receivers of telephones and speaking tubes." W. C. Latham and J. T. Boyes. March 10th.

5,606. "Improvements in electro-thermic surgical forceps." A. J. Downes. March 10th. (Complete.)

5,619. "Improved electrical connection between terminal and trolley head of electric tramcars." T. B. Birkby. March 11th.

5,643. "Improvements in, or relating to, certain classes of electrical metering and recording instruments provided with, or working in conjunction with, clocks running at normal time." Electric and Ordnance Accessories Co., Ltd. and L. J. Aron. March 11th.

5,646. "Improvements in electric arc lamps." J. W. Ewart. March 11th.

5,660. "A new or improved coil, or combination of coils, for inducing electric currents." C. C. Fontaine. March 11th.

5,697. "Improvements in electric controlling or switch device suitable for use in connection with electric arc and incandescent lamp circuits and for other purposes." T. W. Peckham, J. J. Glass and J. Coleman. March 11th.

5,698. "Improvements in lamps with electric lighting device and supplemental wick." A. L. Lind and C. H. Carlsson. March 11th. (Complete.)

5,735. "Improvements in and relating to the overhead equipment of electric tramways and cars therefor." J. T. Pearson. March 12th. (Complete.)

5,742. "Improvements in apparatus for indicating the presence of leaks on electric circuits." R. J. Bott. March 12th.

5,743. "The reversible push (electric bell)." J. N. Eustace and W. Smith. March 12th.

5,744. "Improvements in electrical measuring instruments." W. C. Fisher. March 12th.

5,784. "Improvements in, and relating to, Hertzian wave telegraphy." Sir Oliver J. Lodge and A. Muirhead. March 12th.

5,824. "Improvements in, or relating to, the construction of trolley wheels used in overhead electric traction, also applicable to other friction wheels." M. Mattok and A. Whittaker. March 13th.

5,845. "Improvements in the construction of electrodes for storage batteries." H. F. Joel, senior. March 13th.

5,865. "Improvements in, and relating to, electric brakes." W. K. L. Dickson. March 13th.

5,873. "Improvements in electric arc lamps." T. Hamilton Adams. March 13th.

5,888. "An improved automatic cut-out switch." C. R. Heap. March 13th.

5,891. "Improvements relating to electric batteries." J. Portalier. March 13th. (Date applied for under Patents Act, 1901, September 13th, 1902, being date of application in Belgium.) (Complete.)

5,893. "Improvements in electric sparking plugs." W. P. Thompson. (A. Vogel and R. Egg, Switzerland.) March 13th. (Complete.)

5,911. "A smoke-actuated electric fire-alarm." A. W. Turner. March 14th.

5,913. "Trolley rope guard for tramcars." E. S. Kabslake. March 14th.

5,918. "Improvements in and relating to a switch for use in charging storage or secondary batteries." W. G. Heys. (The Hutchinson Acoustic Co., U.S.A.) March 14th. (Complete.)

5,937. "Improvements in controllers for electric motors." J. Bush and M. T. Medway. March 14th.

5,938. "Improvements in and relating to conductors and collectors for electric railways and tramways." D. Kempt. March 14th. (Complete.)

5,944. "Improved holder for incandescent electric lamps and the shades for same." C. E. Zimdars. March 14th.

5,967. "Improvements in sparking plugs." H. Plumbridge. March 14th.

5,969. "Improvements in electrical signalling apparatus for electric tramways." J. E. Spagnoletti and The Electric Railway Signalling Syndicate, Ltd. March 14th.

5,973. "Improvements in inter-communication telephone wall sets and the connections of wiring thereof." J. Berliner and I. B. Birnbaum. March 14th. Complete.)

5,984. "Improvements in holders particularly for incandescent electric lamps." T. Gagowski, F. Wirlitzek and J. Zymelka. March 14th.

5,989. "Improvements in connection with electric sparking devices especially intended for firing the charge in internal combustion engines." E. F. Bradley and H. Edmunds. March 14th.

PUBLISHED SPECIFICATIONS, 1902.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

7,736. "Improvements in extinguishing electric arcs." R. H. Read. Dated April 2nd.

7,792. "Improvements in electric cooking and heating apparatus." L. Lutz. Dated April 3rd.

7,809. "An improved electric arc lamp." H. S. Scott and others. Dated April 3rd.

8,020. "Improvements in or connected with controlling and engaging apparatus for railway points and signals operated by electricity." A. Veelemans. Dated April 5th.

8,189. "Improvemets in electric circuit regulating devices." G. P. McDonnell. Dated April 8th.

8,190. "Improvements in controlling means for electric motors, the invention being applicable to electric elevators." Otis Elevator Co. Dated April 14th.

8,315. "Improvements in couplings for electrically-lighted table decorations." E. M. Chapman. Dated April 10th.

8,583. "Improvements in pincers particularly adapted for the use of electricians." R. Haddan. Dated April 12th.

8,653. "Improvements in holders for electric lamp shades, reflectors, and the like." F. McIntyre. Dated April 14th.

9,325. "Improvements in insulating tubes for the windings of electric machines, such as motors and the like, and in the process of making same." M. Meirowsky. Dated April 22nd.

9,501. "Improvements in telephone jack-strips." L. M. Ericsson. Dated April 28th.

9,813. "Improvements in the electrolytic production of a bleaching liquor and caustic alkali lye, and in apparatus employed therein." A. J. Boult. (H. Seibert and G. Sempel, Germany.) Dated April 28th.

9,849. "Improved means or method of connecting incandescent electric lamps in festoons and for other like temporary uses." W. Barker. Dated April 29th.

9,977. "Improvements in pole-pieces for dynamo-electric machines." British Thomson-Houston Co., Ltd. (A. Churchward, United States.) Dated April 30th.

9,978. "Improvements in pole-shoes for dynamo-electric machines" British Thomson-Houston Co., Ltd. (A. Churchward, United States.) Dated April 30th.

10,097. "Improvements in conducts for electric mains and in the jointing of same." L. Barlow and J. Young. Dated May 2nd.

10,132 "Improvements in portable secondary or other electric batteries, accumulator plates, and the like." L. Bristol. Dated May 7th.

10,538. "Improvements in or connected with trolleys for use with overhead conductors in electric traction." C. Stoll. Dated May 7th.

10,457. "Improvements in storage batteries." J. Redding and others Dated May 6th.

10,594. "Cleats for fastening electric wires or cables in casing or other carrying arrangement, temporary or otherwise, or for permanent fixing to walls, ceilings, roofs and the like." V. W. Riley and H. W. Rowing. Dated May 8th.

10,943. "Improvements in trolley guards for electric railways and the like." E Gagne and P. Bonneau. Dated May 13th.

11,072. "Improvements in switches for electric circuits." British Thomson-Houston Co., Ltd. (J. J. Wood, United States) Dated May 14th.

11,073. "Improvements in means for controlling electric circuits." British Thomson-Houston Co , Ltd. (J. J. Wood, United States). Dated May 14th.

11,080. "Improvements in multipolar electric switches." British Thomson-Houston Co., Ltd. Dated May 14th.

11,165. "Improvements in switch-box apparatus used for testing, standardising or calibrating electric instruments and in measuring electric currents thereby." G. L. Addenbrooke. Dated May 15th.

11,290 "Improvements in electric switches and regulating sockets, chiefly designed for use in connection with incandescent electric lamps." H. H. Lake. (W. P. Pinckard, United States.) Dated May 16th.

11,339. "Improvements in portable telephonic apparatus for the use of persons with impaired hearing." W. E. Heys. (The Hutchinson Acoustic Co., United States.) Dated May 16th.

11,340. "Improvements in dry or semi-dry cells of primary or secondary electric batteries." W. E. Heys. (Huchison Acoustic Co., United States.) Dated May 17th.

11,343. "Improvements in charging switches for secondary electric batteries." W. E. Heys. (The Hutchison Acoustic Co , United States.) May 16th.

11,374. "Improvements in electric railways on a surface contact system." B. Cruvellier. Dated May 17th.

11,427. "A new or improved endless electric conveyor for conveying tin plates from the bath of molten metal to a suitable or desirable place." J. Baxter and others. Dated May 17th.

11,487. "Improvements in electric cables." G. Harrison. Dated May 20th.

11,523. "Method of and means for transmitting electrical energy in installations for traction purposes." M. Déri. Dated May 20th.

11,869. "Improvements in electric devices for igniting mines." W. Norres. Dated May 24th.

11,940. "An improved frog for overhead conductors or lines of electric tramways or railways." The Palatine Engineering Co., Ltd., and R. Blakiston, Dated May 26th.

11,950. "Improved brush holder for dynamo-electric generators and motors and the like." C. Mitchell. Dated May 26th.

12,110. "Improved means and apparatus for effecting telephonic intercommunication." J. Young. Dated May 27th.

12,121. "Improvements in and relating to telegraphic apparatus." A. Damaskinos. Dated May 27th.

12,309. "An improved electric heating device." F. de Mare. Dated May 29th.

12,586. "Improvements in connection with electric tramcars." J. Black and T. Hogg. Dated June 2nd.

12,547. "Improvements in making electrolytic baths." F. von Liebermann. Dated June 2nd.

12,554. "Improved means and apparatus for telephonic communication." Siemens Bros. & Co. (Siemens & Halske.) Dated June 2nd.

12,578. "Improvements in current reversing mechanism for oscillating electricity meters." P. M. Justice. (Messrs. Theiler & Co. and P. Eibig, Germany.) Dated June 2nd.

12,581. "Improvements in electro-magnetic traction or driving apparatus for railways, lifts, machine tools and other appliances." A. Zehden. Dated June 2nd.

12,582. "An improved system of electric lighting." W. L. Wise. Dated June 2nd.

12,706. "Improvements in wireless telegraph systems." C. D. Ehret. Dated June 3rd.

12,755. "Method for reducing or entirely suppressing synchronising currents of single or multi-phase alternators working in parallel." E. Kolben. Dated June 4th.

12,870. "Improvements in or connected with apparatus for charging electric accumulators." Société Lespagnol and Merigues. Dated June 5th.

12,956. "Improvements in transmitting apparatus for electric telegraphs." P. M. Justice. (The Rowland Telegraphic Co., United States.) Dated June 6th.

13,170. "Trolley wire support." E. Hill. Dated June 10th.

13,171. "Trolley-wire support." E. Hill. Dated June 10th.

13,175. "Improvements in equalising appliances for interconnected polyphase current systems." Siemens Bros. & Co., Ltd. Dated June 10th.

14,126. "Improvement in telephones for diving and like purposes." W. A. Gormen and A. Graham. Dated June 21st.

14,578. "Improvements in switches for electrical glow lamps." The Edison and Swan United Electric Light Co., Ltd., and J. Shepherd and H. D. Gover. Dated June 30th.